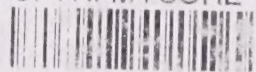


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DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

BIBLIOGRAPHY
OF
INDUSTRIAL DRYING

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~~I.2~~

VOLUME II

DECEMBER 1951

Price 27s 6d (3 Volumes)

The Bibliography of Industrial Drying is divided into five sections and presented for convenience in three volumes. A contents list for the relevant sections is included at the beginning of each volume and a list of sources quoted in the text, is given at the end of Volume III.

F8,3:6;4 "a
NSI.2

VOLUME I. Section 1. Principles of Drying

" 2. Drying Processes and
Equipment

VOLUME II. Section 3. Agriculture

" 4. Food

VOLUME III. Section 5. Industrial Materials

List of Sources Quoted in the Text

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2434

Bibliography of

(Reprinted with minor amendments, November, 1952)

2434 ✓

VOLUME II - CONTENTS

SECTION 3

AGRICULTURE ✓



	Pages	Item Nos.
General	301 - 303	1 - 22
Soil Moisture	303 - 304	23 - 29

GRAIN ✓

Equipment	304 - 307	30 - 53
General Process	308 - 310	54 - 73
Bin Drying	310 - 312	74 - 82
Electric Drying	312 - 313	83 - 88
Sorption Drying	313	89 - 90
Vacuum Drying	313 - 314	91 - 94
Fuel	314 - 315	95 - 98
Principles of Drying	315 - 317	99 - 104
Moisture Detn.	317 - 318	105 - 110
Storage	318 - 319	111 - 119
Seeds	319 - 321	120 - 127
Linseed	321	128 - 129
Maize	321 - 323	130 - 137
Malt	323	138 - 141
Rice	323 - 324	142 - 146
Peanuts	326. 378	452/3. 463

GREEN CROPS ✓

Equipment General	324 - 333	147 - 204
Equipment Continental	333 - 336	205 - 217
General Process	336 - 345	218 - 267
Economics	345 - 347	268 - 281
Barn Drying	347 - 352	282 - 309
Field Drying	352 - 353	310 - 314

GREEN CROPS (Contd.)

Pages

Item Nos.

Beet Tops	354 - 355	315 - 323
Beet Root	355 - 356	324 - 331
Crushing	356 - 357	332 - 336
Vacuum Drying	357	337
Fire Risk	358	338 - 339
High Frequency Appln.	358. 378	340 - 465
Infra-Red Heating	358	341 - 342
Storage	359	343 - 346
Nutrition Aspects	359 - 368	347 - 390
Physical Aspects	368 - 369	391 - 400

HOPS	369 - 370	401 - 403
-------------	-----------	-----------

PYRETHRIN	370	404 - 405
------------------	-----	-----------

TEA	370 - 371	406 - 411
------------	-----------	-----------

TOBACCO	371 - 373	412 - 430
----------------	-----------	-----------

ADDENDUM	373 - 378	431 - 465
-----------------	-----------	-----------

SECTION 4**FOOD**

Pages

Item Nos.

**FOOD. General
FOODS. Various**

Butter Fat	381 - 399	1 - 103
Cheese	399 - 402	104 - 119
Egg Substitute	399	105
Flour	399 - 400	104 - 107
Macaroni	400	108
Sausage	388/9. 400	45/a. 109/11
Soup	401	112 - 115
Sugar	401	116
	402	117 - 119
	Sect. 5	313 - 328

	Pages	Item Nos.
BAKING	402	120 - 122
COFFEE EXTRACT	403	123 - 129
EGG ✓	404 - 410	130 - 161
FISH ✓	410 - 416	162 - 194. 689
FRUIT JUICE ✓	416 - 420	195 - 217
GLUTEN ✓	388 - 420/1	218 - 223. 45
MEAT ✓	421 - 430	244 - 265
MILK ✓		
General Process	430 - 436	266 - 302. 692-4
Whey	436 - 438	303 - 311
Chem. Phys. Bact.	439 - 442	312 - 325
PECTIN ✓	442/3 . 518	326 - 329. 684
FRUIT ✓		
General Process	443 - 449	330 - 360
Granulated	449 - 450	361 - 362
FRUITS various	450 - 458	363 - 410
Apples	450	363 - 368
Apricots	451	369 - 370
Bananas	451	371 - 373
Cherries	452	374
Citrus Fruits	452	375 - 376
Cranberries	452	377
Dates	453	378 - 380
Figs	453	379 - 383
Guavas	453	384 - 385
Huckleberries	454	386
Nuts	454	387 - 388
Olives	454	389 - 390
Peaches	455	391 - 393
Pears	455. 518	394/6. 685
Peppers	456. 493	397. 568/9

FRUIT (Contd.)

	Pages	Item Nos.
Pineapple	456	398
Prune	456 - 457	399 - 404
Pumpkin	457	405
Sultanas	457	406
Tomatoes	457 - 458	407 - 409
Walnuts	458	410

VEGETABLES (AND FRUIT)

Equipment	458 - 461	411 - 427
General Process	461 - 478	428 - 506
Blanching etc.	478 - 481	507 - 519
Vacuum Drying	481	520
Waste Heat	481 - 482	521 - 522
High Freq. Heating	482 - 483	523 - 526
Domestic Drying	483 - 486	527 - 540
Costs	486 - 487	541 - 544
Vegetables Various	487 - 493	545 - 571
Asparagus	487	545
Beans	487 - 488	545 - 549
Cabbage	489 - 490	550 - 554
Carrot	490	555 - 559
Mushrooms	491 - 492	560 - 562
Onions	492	563 - 564
Paprika	492	565
Peas	492 - 493	566 - 567
Sauerkraut	493	570
Soup Ingredients	493	571
Vegetables Powdered	493 - 495	572 - 577
Compressed	495	578 - 579
Packaging & Storage	495 - 497	580 - 589
Nutritional Aspects	497 - 504	590 - 613
Chem. and Phys. Aspects	504 - 507	614 - 628
Standards	507 - 508	629 - 630
POTATO ✓	508 - 517	631 - 676
YEAST	517	677 - 681
ADDENDUM	518 - 519	682 - 694

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grain to baffles on the other side which are inclined at the angle
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drying to a natural moisture content. Grain so treated is claimed
to be less readily attacked by insects and fungi and less easily
broken.
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COMBINE HARVESTING AND GRAIN DRYING. Discusses (1) the use of
combine harvesters and operations involved, (2) subsequent drying
of grain, with reference to drying temperatures, storage and
moisture content, capacity and cost and the importance of adequate
transport, and (3) storage of grain on the farm.
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GRAIN DRYERS. The movement of a plunger when applying a specific
pressure to periodic samples of the dried grain varies as the
moisture content, and is made to cause diversion of the dried grain
for redrying and when the moisture content exceeds a specific
value predetermined.
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Samples of Manitoba wheat with a natural moisture content of 13 to
14% were dried to sub-normal moisture contents (about 7%) in a
batch drier under controlled conditions at different rates of air
flow and at air temperatures of 160⁰, 180⁰, and 200⁰F (71.11⁰,
82.22⁰, and 93.33⁰C). After drying, the wheat showed improved
milling characteristics and yielded a higher percentage of
endosperm than the control wheat. Baking and extensometer tests
showed that, under the drying conditions used, there was no evidence
of marked change in baked quality on drying to a moisture content
of about 7%, in spite of the fact that the wheat in the most extreme
cases attained a final temperature of 185⁰F (85⁰C).
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GRAIN DRYING IN SACKS. A long concrete hollow platform with
rectangular apertures (about 45) in 2 parallel rows on which 1 cwt.
sacks of wheat were laid, one to each aperture. A warm air blast
driven from a "Nu-way" oil fed furnace, was reported to be capable
of removing 1% of moisture for 1 gallon of petrol, per hour. The
hot air and exhaust was 5,600 c.f.m. at 0.7 inch water gauge.

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71. Smith, G.R., Miller, R.C. Agric. Engng, St. Joseph, Mich., 1943, 24, 3-4.
 and Junnila, W.A.
FORCED VENTILATION OF HIGH MOISTURE GRAINS. Deals with studies of forced ventilation for drying crops of high moisture content, such as soy-beans, giving specifications of bins used. It is concluded that spoilage of grain with a high moisture content during cool weather can be prevented by ventilating with a moderate amount of air and, if a small amount of heat is added, the grain can be dried under winter air conditions. Further tests with fans, flues used in the barn-curing of hay and flues connected to blowers, for ventilation of grain during storage, are described.
72. Sprenger, Prof. Dr. J.J. Landbouw-voorlichtings-dienst.
 Mededeling No. 55. Central Inst. voor
 Landbouw-Kundigug Onderzoek 1948. 109 p. p.
 H. Veenman and Zonen. Wageningen.
GEAANDROGEN EN GRAANDROGERS. Description of machinery. Some physical aspects.
73. Wilman, R. H. Agric. Engng, St. Joseph, Mich., 1941, 22, 2-4.
SHRINKAGE OF ARTIFICIALLY DRIED SEED CORN. Studies made with bin types of seed corn drier have yielded information with regard to shrinkage of ear corn by weight and volume, as related to the percentage of moisture removed from the grain. Results are shown graphically.

Bin Drying

74. Anon. (Farm Imp. and Mach. Rev., 1 Aug. 1947, 73, 365-366).
NEW GRAIN DRYING TECHNIQUE. An illustrated description of an installation at "Stawert", Heather Yards, near Leeds. The design is similar to that being tested at the National Institute of Agric. Engng., Askum Bryan. Some modifications have been introduced to overcome some of the major disabilities of the prototype, in particular that of excessively slow drying of the grain towards the top of the bins.

75. Anon. (Elect. Times, 9 Sept. 1948, vol. 114, 303-304).

DRYING OF GRAIN. This brief article gives operating details of a large scale grain drying installation now in operation at Leighton Buzzard. The principle of the drier is that of blowing warm dry air through the grain as it is stored in bins. Some details of the electrical installation and loading are given.

76. ---- N.I.A.E. 25p.p. Report March 1949.

DRYING OF GRAIN IN STORAGE BINS WITH CONDITIONED AIR. Description and details of construction of grain drying equipment for farm. Ventilated with conditioned air. Curves for relationship of grain moisture with R.H. of the air.

77. Anon. (Times, 11 Oct. 1948).

GRAIN DRYING. CHEAP PLANT FOR THE FARM. The problem of drying and storing grain has been solved to his satisfaction by a Bedfordshire farmer, Mr J. T. Hawkins, working on plans prepared by the National Institute of Agricultural Engineering now at Wellesbourne, Silsoe, Bedfordshire. The plant consists of six ventilated bins, built as small circular silos holding altogether 140 tons of grain. Slightly warmed air is forced slowly through a porous floor into the silos, the average drying rate when the silos are full being $\frac{1}{2}\%$ moisture in 24 hours. This season, with grain off the combine showing more than 20% moisture, the silos were half-filled and the grain dried at the rate of 1% a day.

78. ---- B.I.O.S. Report No. 829 p. 19.

FANS BLOWING AIR ON TO GRAIN 1 METRE THICK ON AN UPPER FLOOR.

79. Claydon, E. C. (Elect. Rev., 10th September, 1948, 143, 406-408).

GRAIN DRYING - INSTALLATION AT LEIGHTON BUZZARD, BEDF. Dried threshed grain is placed in a reinforced concrete bin of twenty-five tons capacity, having porous floor of brick and blocks, supported about a yard from the ground on brick walls. Warm air reaches centre of base of each bin through a 2 foot square concrete duct. Air-driving fan is powered by a 7 h.p. squirrel-cage motor and heat is provided by a 21-k.w. air heater. A detailed description and diagrams of the heater and circuit are given.

80. Garrod, G. H. Agriculture 56(3) 93-102 June 1949
 Brit. Agric. Ex. Office.
 GRAIN DRYING. Report of Conference, Maidstone, on 24 Feb. 1948.
 Deals with the necessity of drying grain obtained with the increasing
 use of combine harvesters. Advocates electricity for drying and
 quotes a case where total current was 3,820 units for 166 tons of
 grain and 6 tons of water removed (intermittent heating),
 = about 1000 B.T.U. for lb. water removed.
81. Peterson, L. E. (Amer. Artisan, July, 1948, 117, (7), 101-104).
 CORRECT PRACTICE IN FARM VENTILATION. II. CORN DRYING. Describes
 a method to dry seed corn in a bin with the forced circulation of air
 warmed to 105°F., which dries the corn to 13% moisture, in from 75
 to 90 hours. The apparatus used is described and illustrated.
82. Wright, A.H., Dufee, F.W. Univ. Wisconsin. Madison. Dept. of
 Agronomy and Agric. Eng. 1939.
 BIN METHOD OF DRYING SEED CORN. Report includes drying, construc-
 tion, types, capacity, fuel quantity, temperatures, rate of drying,
 cost of construction and drying, and other novel features not known
 to the trade and producers. \$1.05/copy from the Bulletin Dept.
 The University.

Electric Drying

83. Anon. Elec. Review 136.61-2.12.1.1945
 DRYING GRAIN ELECTRICALLY.
84. ——— (Elect. Rev. 20 Sept. 1946, 139, 463-4).
 ELECTRIC GRAIN DRYING. A short illustrated note on the past year's
 operation of an electrically heated and driven grain drying plant
 installed at Wilkins Brothers farm at Bampton, Oxfordshire.
85. ——— (Elect. Times, 22 Mar. 1945, 107, 359).
 GRAIN DRYING BY ELECTRICITY. The plant was originally coke fired
 but was converted to electric heating for the 1944 season. It
 consists of a number of heating elements mounted in trunking. The
 total load is 171 kw divided into two sections of 99 and 72 kw,
 respectively, the first of which is manually, and the second
 thermostatically controlled. A fan driven by a 15 h.p. motor
 circulates the air. The cost of drying per ton is higher than
 with raw fuel, but accurate temperature control enables the plant
 to be run nearer to the critical temperature, there is greater
 cleanliness, and the plant can be operated by one man instead of
 two. During the 1944 harvest approximately 160 tons of grain were
 dried. The units per ton consumed varied from 60 to 305, the
 latter figure being for very wet grain, which was put through the
 drier twice and had 12% of moisture removed as against an average
 of 4 to 6%. Average consumption per ton was 179 units for an
 average removal of 7.05% moisture.

86. Brown, C. A. C. Elect. Times 16/11/1944, 106, 548-9; E.R.A. Abst.
GRAIN DRYING - ALL-ELECTRIC POSSIBILITIES. After reviewing the present position under the heading of mechanical harvesting, grain drying machines, power load and electric heating the author indicates some of the problems yet to be solved.
87. Cover, W. (Osram Bull., Jan. and July 1946, 23, 19 70-73).
ELECTRICITY FOR GRAIN DRYING. I AND II. A brief account of the grain drying process together with descriptions of typical installations. Consideration is given to some of the economic problems involved in the use of these plants.
88. R. Wells & Co. Farm Impl. Mach. Review Sept. 1 and Oct. 1, 1948.
College Hill, London. The C.P.C. all electric dryer. Portable, £500. Rotatable perforated cylinder in 2 sections, the third being for cooling. Rate of feed dependent on requirements of the grain.

Sorption Drying

89. Anon. Br. Farm Mechanisation. Aug. 1950.
Farmers Weekly p.41 3.3.1950.
GRAIN DRYING PROCESS. A farm dryer designed by Spillers. Silica gel is used. Claimed that 20 tons grain can be dried per hour at 2/- per ton for fuel and power, and the labour costs are negligible.
90. Rao, K. S. J. Phys. Chem. 45 531-9 1941
See under "SORPTION."

Vacuum Drying

91. Dienst, K. Z. ges. Getreidew., 1939, 26, 41. Brit. chem. physiol. Abstr. B, 1939, p. 540.
PROCESSES AND EFFECTS IN THE TREATMENT OF GRAIN BY HOT AIR AND UNDER VACUUM (transl. title). Reports that vacuum-conditioning surmounts the difficulties of uniform drying of grain. Diagrams of the plant are given. It was most economical to dry at a low temperature, but for special purposes the temperature could be raised.
92. Dienst, K. B.P. 516,124 (December 22nd, 1939).
Addition to B.P. 452,546.
IMPROVEMENTS IN OR RELATING TO THE DRYING OF GRAIN. Describes a grain drying apparatus in which a vacuum chamber is connected to the vacuum drier. In this chamber a heat exchange device is separated from the points of entrance and exit of the material to the space through which the material is exposed only to the action of the vacuum. A common air lock device may be placed between the vacuum drier and vacuum chamber.

93. Huzenlaub, E.G. and Rogers, J.H. E.P. 520,545 (April 29th, 1940). Brit. chem. physiol. Abstr. B, 1940, p. 578.
IMPROVEMENTS IN VACUUM-DRYING CYLINDERS, PARTICULARLY FOR GRAIN.
 Batch drying of grain (and especially rice) is effected in a rotary cylinder, which is provided with a jacket and with longitudinal internal tubes leaving a cruciform space to facilitate charging and discharging. Condensed steam in the headers is discharged by lifting buckets.
94. Huzenlaub, E.G. B.P. 601,162 25.4.45 B. III Nov. 1948. 392
 Rogers, F.H.
VACUUM DRYING CYLINDERS. Injecting steam along pipes passing through the grain in a rotatable steam jacketed vessel (cylindrical) with maximum contact area and screwed contact arrangement. Temperature and pressure within the dryer are raised, after which water vapour is rapidly removed by vacuum, causing rapid and even drying of the grain.

Fuel

95. Anon. Gas Wld. 18/7/1942, 117, Industrial Gas 51.
 The application of scientific methods to farming has resulted in the opening up of vast new fields for various types of fuel, among which coke holds a foremost place. In view of this, it is less surprising than at first appears that the London and Counties Coke Association should be issuing a series of booklets on agricultural subjects, of which the first, "Combine Harvesting and Grain Drying," has just been published. The greater portion of the book describes in great technical detail the various forms of harvesting machines now in use, but the concluding section deals with fuel and furnaces for grain drying, and it is here that members of the gas industry will find most to interest them. The most essential feature of furnaces used for grain drying is that they should maintain a steady temperature with the minimum of attention and the London and Counties Coke Association has developed special hopper feed furnaces which fulfil these conditions.
96. London and Counties Coke Association (Modern Agric. Equipment ser. 1942, No. 1, 64pp. 2s. 6d.).
COMBINE HARVESTING AND GRAIN DRYING. Several dryers are described and there is a section dealing with furnaces for grain drying. Fuel costs for tractors used in combine harvesting are analysed.
97. Chartres, C. B. (Fuel and the Future, Ministry of Fuel Conf., Preprint, Oct. 1946, 5pp).
GRAIN DRYING AND THE COMBINE HARVESTER. The author estimates the consumption of coal, coke and liquid fuels for the 1946 harvest and concludes that, when complete, the change-over from steam engine to tractor for threshing is expected to effect a saving of 25,000 tons

of coal per annum. Figures are given for the fuel consumption in grain drying. Local Dryer or Area Dryer. Types: Tray Dryers, Vertical dryers. Maximum Temperatures for grains. Av. removal 6% moisture. Theory, 80°-150°F 1,494 B.T.U./lb. Water, but dryers may use 3,000 B.T.U.s/lb. Water removed. 56 lb. coke is used per acre of grain. The advantage of a bin dryer is that the air leaves nearly saturated, but is offset by the large volume of air to be blown. Cost of installation less. Tests are in hand to ascertain commercial results. 4,000 combines will increase to 10,000 within a few years, 1 central dryer could serve 50 - 100 combines, if properly designed and fuel consumption less than for individual farm dryers.

98. Hubbard, W. A. (Pap.to Joint Conf.,Insts.Petrol.and Fuel, on Modern Applications of Liquid Fuels, Sept.1948; -B'ham: The Insts., 1948, advance copy,16pp.).

OIL FIRING FOR GRAIN DRYING, HOP DRYING AND MALTING. In order to demonstrate that low-temperature crop-drying processes offer a proper and permanent field for the use of fuel oil, the speaker gave a general description of the drying plants most commonly used, the types of oil-firing equipment which have proved in practice most suitable for application to these dryers and the methods of automatic control generally adopted. He also discussed the possibilities of further economies in the use of fuel oil for low-temperature drying in relation to the design of the dryer, and the design and application of the oil-firing equipment.

Principles of Drying

99. Babbitt, J. D. Canad.J.Res.27 55 1949
OBSERVATIONS ON THE ADSORPTION OF WATER VAPOUR BY WHEAT. Adsorption and desorption isotherms for wheat and flour were obtained at various R.H. in atmospheres of water vapour only. Time to equilibrium was measured and a theory is proposed to account for the rate of adsorption. This is governed largely by the time taken for moisture to diffuse up to the surface of the wheat. This was much longer than the time registered for penetration into the surface.
100. Cashmore, W. H. Agric.: J.Minist.Agric.,1942,49,144.
TEMPERATURE CONTROL OF FARM GRAIN DRYERS. Good line harvesting in England was found to be unreliable unless there was easy access to a grain drier. For purposes of controlling grain drying, it is more convenient to work to hot air temperatures which must be kept below a certain limit, the critical temperature. Critical temperatures for grain required for seed or barley for malting, over a range of moisture contents, are 190°-200°. Wheat for milling may be dried to a temperature of 160°-170° without damage to milling and baking qualities, provided that the rate of drying is not

excessive. Grain for feeding purposes on the farm can be dried at temperatures up to 100°F(37.8°C) without harm. Linseed, mustard and other oily seeds should not be exposed to an air temperature higher than 115°F(46.1°C). Grain leaving a drier should be cooled to at least 75°F(23.89°C). Degree of dryness for storage is dealt with and a method for keeping conditions constant is given.

101. Henderson, S. M. Agric.Engng, St. Joseph, Mich., 1943, 24, 367.
RESISTANCE OF SHELLED CORN AND BIN WALLS TO AIR FLOW. Describes investigations of the passage of air through shelled corn and bin walls, especially in the case of the low air pressures encountered when natural ventilation is used in drying shelled corn, and gives a formula for calculating the rate of air flow. The effects on the rate of air flow of cleanliness of corn and presence of foreign material and settling of the corn were examined. The resistance to air flow of perforated steel sheets, such as are used for ventilators, walls and floors in grain bins, both alone and with corn, was determined, as well as the effect of openings in the floor. The data obtained can be used to determine either the rate of flow through shelled corn for a given pressure or the static pressure required to produce a given rate of flow, and such factors as the presence of cracked corn and foreign material and the reduction in flow due to the added resistance of openings in the floor can also be taken into account.

102. Leniger, H. A. Landbouwkundig Tijdschrift. 61 No. 10
697-710 Oct. 1949. in Dutch.
THE TECHNOLOGY OF GRAIN DRYING. A treatment of the various factors governing grain drying. Curves of absorption isotherms and of drying rates at certain temperatures. The methods and effects of the passage of air through the grain in different ways are discussed, and emphasis is laid on the need for more data on rates of drying, air resistance and admissible temperatures.
1. Initial and final water content.
2. Admissible drying conditions.
3. Rate of drying.
4. Choice of method. Infra. Red and H.F. are considered unsuitable. Choice between air and vacuum drying.
5. Types of dryer.
Problems are stated.

Field Crop Abstracts 3(2) April 1950
p. 68.

103. Sprenger, J. J. I. Centr. Inst. of Agric. Res. Wageningen.
1949. p. 84-8.
GRAIN DRYING. Investigation into the vapour pressure-moisture relations of grain by an oven method and direct weighing.
Field Crop Abstracts April 1950.

104. Sprenger, J. J. I.

Landbouwtijdschrift 62 89-103 1950

Centr.Institute for Agric Res.Wageningen

RESEARCH WITH A VIEW TO IMPROVEMENT OF GRAIN DRYERS. A preliminary report of research at Wageningen which is concerned with measurement of drying properties and other constants of grain and seeds. It is hoped to build a Model dryer for experimental purposes using hot air.

Field crop abstracts April 1950.

Moisture Determination

105. Fisher & Jones

Jnl.Agric.Science 18p.649 1928

DETN. OF MOISTURE IN WHEAT. Charts for varying times and methods formulated on an arbitrary basis.

106. Fosnot, R. H.,

Cereal Chemistry 22 41-49 1945

Haman, R. W.

CEREAL PRODUCTS: MOISTURE DETERMINATIONS WITH KARL FISCHER REAGENT. Details of test, and its variations for different types of grain.

107. Hartshorn, L. and

(Milling, Jan. 8th, 1944).

Mounfield, J. D.

THE ESTIMATION OF MOISTURE IN GRAIN. The electrical method of determining moisture-content is considered. If a moist powder is placed between two metal plates, both the electrical conductivity and the electrical capacity depend on the moisture-content of the powder. Some electrical moisture meters measure the conductivity, others the capacity; an instrument is developed which depends on the measurement of both these quantities. The necessary electrical sensitivity has been obtained in an instrument that is compact, portable, and robust; it runs from the ordinary electric supply mains (200 to 250 volts A.C., 50 cycles) requiring no batteries or auxiliary power unit; the operation is extremely simple and rapid, and does not require skilled labour. The instrument has to be calibrated before use.

108. Hlynka, I., Martens, V.,

Canad.Jnl.Res.27F 382-97 1949

and Anderson, J. A.

MOISTURE DETN. Comparison of 10 different electrical meters for detn. of moisture in wheat. Resistance meters appeared to be more reliable than dielectric meters.

109. Nuret, H., Dubois, M.

Bull.Anciens.Elèves.Ecole Franc.Meuniers
80-8 - 1949

RAPID DETN. OF WATER IN GRAIN. The Electrical method is compared with rapid drying methods, namely at 130°F; for one hour at 150-200°F, and the rapid drying data of Chapin (C.A.33 8141). In addition, the use of a torsion heat balance and high frequency methods are discussed. For milling, rapid oven drying methods are preferable.

110. Sisko Ivaska Finland. Suomen Kemistilehti 22A 103-15 1949.
Ch.Alstr.44 7 2804 1950 10 April.
MOISTURE ANALYSIS METHODS, ESPECIALLY THE USE OF CERTAIN AUTOMATIC
MOL-TURE MEIERS FOR GRAIN. Compares several electronic meters
when used on Finnish grain, considerable variations were found.

Storage

111. ---- Agric.Eng.Record.2 200 - 1.1949
GRAIN DRYING AND STORAGE ON THE FARM. A discussion of the
advantage of various methods.
Field crop abstracts 2 April 1950.p.68
112. ---- Agric.Eng.Rec.2 214-5 1949.
MOISTURE CONTENT OF COMBINE HARVESTED GRAIN. The moisture contents
for various methods of storage are given:-
Under 14% - Prolonged bulk storage
14-15.9% - Temporary storage
16-17.9 - Winter storage in sacks
18-19.9 - Temporary sack storage.
Over 20% Drying necessary within a few days.
Half the grain harvested had less than 20%; three quarters had 16 to
22% moisture.
Field crop Abstracts 2 April 1950.p.68.
113. ---- Colonial Research Publ. No.5.pp.42.1950
GRAIN STORAGE IN EAST AND CENTRAL AFRICA: REPORT OF A SURVEY
(OCT. 1948 - JAN. 1949).
114. Dexter, S. T. Quarterly Bull.Mech.Agric.Exp.Stn.31.275-282.1949
A MODIFIED WET AND DRY-BULB THERMOMETER TECHNIQUE FOR DETERMINING
THE MOISTURE CONTENT OR STORAGE PROPERTIES OF DRY MATERIALS.
Instead of water on the wet bulb, a solution of a salt appropriate
to the humidity of the sample is used, so that evaporation would be
small, e.g. Na Cl for grain at 15% M. (75% humidity), and MgCl₂
for dry materials like breakfast foods. Expts. were carried out
also on corn, barley, oats, beans, sugar beet pulp.
115. Enrova, A. A. C.R.Acad.Sci.U.S.S.R., 1939, 24, 800. Brit.
Chem.Physiol.Abstr.B, 1940, p.313.
CHANGES IN THE NUMBER OF MICRO-ORGANISMS IN ELECTRICALLY DRIED GRAIN
(transl. title). The number of micro-organisms in grain dried in
an electric drier was increased by contamination with air and then
decreased by mechanical action of the air current in the
refrigerator compartment.

116. Kirk, L. E., Lee Ling and Oxley, T. A. Food and Agric.Org.U.S.A.Agric.Study No. 6. 1948. 41pp.
STORING AND DRYING GRAIN IN CANADA, U.S.A., AND THE U.K. Maximum drying temperatures. Safe moisture contents, and Ministry of Agriculture recommendations. Bin ventilation has been extensively studied in recent years. Natural and forced draft with heated and unheated air. Stationary and portable equipment are described. Herbage Abstracts, April 1950.
117. Mohs, K. Z. ges. Getreidew., 1941, 28, 7, Chem. Zbl., 1941, 1, 2335. Chem. Abstr. 1943, 37, 5148.
DRYING OF GRAIN AND FLOUR (transl. title). Construction of shaft driers, drum driers and various conditioning systems is discussed. The advantage of storing flour or meal in paper rather than jute bags is pointed out. Flour can only be stored satisfactorily in closed containers if the water content is less than 10%. If bags are used for storage, the water content must not exceed 14%. A vacuum drier (1½ hours in a 96% vacuum at 60°C) is considered best for drying flour. Flour so dried and containing 10% water can be stored in airtight containers, even at temperatures of 90°C without impairing the baking quality.
118. Oxley, T. A. Trans. Amer. Assn. Cereal Chemists 6 84 1948 D.S.I.R. Libr. P. I. R. B. Reprint.
THE MOVEMENT OF HEAT AND WATER IN STORED GRAIN. The paper outlines the present state of knowledge of the thermal and water relations of grain. Its bearing on grain storage technique and on the deterioration of grain in store is discussed.
119. Quisenberry, K. S. Agric. Eng. v. 30 n 12 Dec. 1949 p. 586-F.
GRAIN VALUES TO BE SAFEGUARDED DURING CONDITIONING AND STORAGE. Causes of losses of grain in storage; harvesting crop; storage of dry sound grain and of damp grain; moisture limits for safe storage; artificial drying. Bibliography.

Seeds Various

120. Anon. (Industr. Heat Engr. July 1947, 9, 141-3).
SEED DRYING BY MECHANICAL METHODS. A seed drying plant installed for Cooper, Taber and Co., Ltd., Witham, Essex by James Gordon and Co. Ltd., is described. The power supply consists of an 8-h.p. gas engine connecting by means of a belt drive to the pulley of the forced-draught fan, which delivers air through the trunking to the air-heater furnace installed in the basement immediately below. The furnace is of the radiator-fin type, thus providing a very large heating surface for heating the air, the whole being enclosed in a brick chamber. Large coke is used for firing the furnace. From this point the air rises, and passes out at the top through ducting to the drying-room floor, where the ducting divides and the warm air passes to the respective groups of drying machines. Another

Installation by the same firm for Hurst and Son, Ltd., Farning, Nr. Colchester in which the entire plant is on the ground floor, is also described.

121. U.S. Dept. Agric. Chem. Ind. p. 250 Aug. 1949.
SEED DRYING BY AIR WHICH HAS BEEN DRIED BY CALCIUM CHLORIDE. The apparatus is easily built on the farm.
122. Gane, R. J. Agric. Sci. 38 81-3 1948. BIII 200 Aug. 1948.
THE WATER CONTENT OF THE SEEDS of:- Soy beans, Linseed, Grass, Onion and Carrot as a Function of Temperature and Humidity of the Atmosphere.
123. Koehler, B. Phytopathology. 1940, 30, 14 (Abstr.).
RAPID SEED CORN DRYING CHECKS SEED INFECTION. Corn ears, picked with a moisture content of about 30%, were dried to a moisture content of 12% (1) at a temperature of 100°F (41.1°C) and 65% relative humidity for 4 days, (2) at 70°F (21.1°C) and 65% relative humidity for 4 weeks and (3) at 70°F (21.1°C) and 86% relative humidity for 3 months, in order to determine the effect of different rates of drying on internal seed infection. Rapid drying was found to reduce internal seed infection by fungi and seems of value in controlling disease.
124. Nicholas, J. E. Agric. Engng, St. Joseph, Mich., 1941, 22, 421.
Musser, H. B.
SEED DRIER USES INFRA-RED ELECTRIC LAMPS. A report of preliminary tests of the drying of seeds (including red fescue, rye grass, tall fescue, brome grass; red clover, barley, soy-beans and wheat), using an infra-red electric drier. Drying machinery and method of operation are described. Results indicated that the infra-red drier made possible the rapid drying of seeds to a safe moisture content (10% or less) for storage, without injury to the seed or to its viability.
125. North, C. Agric. J. Min. Agric. 54 462 1948.
ARTIFICIAL DRYING OF VEGETABLE AND HERBAGE SEEDS. Tabulates maximum temperatures of drying air and maximum permissible moisture content for various seeds for storage. Description of various types of drying equipment e.g. hop kiln, bag dryer, spear conditioner, stationary and mechanical tray dryers and vertical grain dryers.
126. Simons, J. W. Agric. Engng. St. Joseph Mich. 22 112 1948.
DRYING SEED GRAIN WITH CALCIUM CHLORIDE. Data are presented relating to rate of drying, vapour pressure of the air and of the calcium chloride solution through which the drying air is passed, and the temperature and R.H. of the air.

ELECTRICAL DRYING OF GRAIN. An illustrated note on the plant installed at Spalding, Lincolnshire for the drying of sugar beet seed.

Linseed

128. Penman, H. L.

Applied Physics 1(8)p.213 Aug.1950

THE DIFFUSION OF WATER THROUGH FLAX SEED. The main transport of moisture through Flax seed is by diffusion of vapour. Mathematical treatment.

129. Samuels, D.E.J., Tait, E.H.

Br.Jnl.Appl.Physics 1(5)125-131

H.M. Norfolk Flax Est.

May 1950

THE DIFFUSION OF MOISTURE THROUGH FLAX SEED. The controlling factor is found to be diffusion through interstitial air spaces. 9 References.

Maize

130. Caldwell, J. S.,

Canner, 1943, 96(No.19), 12, (No.20),

Culpepper, C. W.

28, (No.21), 15 and (No.22), 20

SUITABILITY FOR DEHYDRATION OF 24 VARIETIES AND STRAINS OF SWEET CORN. The effect of stage of maturity upon the quality for drying purposes of 24 varieties of sweet corn was studied. The pre-cooked corn was dried in a steam-heated, inclined tunnel tray machine, operated parallel-current. Dehydrated samples were examined for colour and general appearance and were re-hydrated, cooked and again graded for colour, consistency, degree of tenderness or toughness of pericarp, presence or absence of starchiness and flavour. The stage of maturity at which the different varieties had optimum quality was uniform for all varieties tested and was that at which the grains had reached an average dry weight of 40 to 50% of the mature dry weight. Corn harvested less mature was watery and poor in body, while corn harvested more mature became progressively tougher, more starchy and less sweet and delicate in flavour. 8 Varieties are considered slightly superior to the others examined, while 17 varieties were graded very good. Colour as a factor in the choice of variety, effects on the product of variations in technique, depth of cut, time or temperature of pre-cooking and drying temperature are dealt with, parallel-current drying is compared with counter-current drying and the effects of sulphuring before pre-cooking are noted. Storage tests to compare types of container and storage conditions are being carried out.

131. Caldwell, J. S.

Food Packer, 28(13)25, 29(1)

Culpepper, C. W., Hutchins, M. C.

86.(4)44.(5). 1947

DEHYDRATING SWEET CORN. Performance of 24 varieties was studied and the various properties of the dried product were investigated.

137. Shedd, C. K. Agric. Eng. St. Joseph, Mich. 30 131-3 1949
PROGRESS IN METHODS OF DRYING CORN. The dry atmosphere is suitable for drying seed corn. Chelling beforehand saves 40% in moisture to be evaporated. Continuous flow, counter current drying has been tried in Iowa.

Malt

138. Van der Ban, P. A. Jaarb. nat. Com. Brouwgerat 11 34-40 1947
DRYING INSTALLATIONS AND CLEANING EQUIPMENT FOR MALTING BARLEY.
Germinating grains reduced by high temperature. Types of equipment described.
139. Dickson, A.D., Shands, H.L. Cereal Chem., 1942, 19, 411
THE INFLUENCE OF THE DRYING PROCEDURE ON MALT COMPOSITION. A series of malts produced from Odebrucker and Wisconsin Earblers barleys under uniform conditions was dried in a kiln at temperatures ranging from 25°C to 85°C. The effect of time and temperature of drying on composition of the malt was determined. Reduction in diastatic power was rapid at temperatures above 50°C and at moisture contents below 6%. α -Amylase was reduced only slightly, if at all. Extract, colour and maltose values of the wort were influenced slightly at the higher temperatures. The drying procedure had little effect on the nitrogen fractions of the wort.
140. Mambish, I., Kaler, I. Spirto-Voduchn. Prom., 1940, 17 (Nov. 1) 11, 32. Chem. Abstr., 1941, 35, 8200
CONTROL OF MOISTURE CONTENT IN MALT (transl. title.). In malt containing 43 to 56% moisture, an hour's drying at a temperature of 50°C left only 5.5 to 14.5% moisture and this residue was removed by raising the temperature to 105°C for 30 minutes. Data on other drying conditions are also presented.
141. Yuditiskii, P., Zybin, F. Spirto-Voduchn. Prom., 1939, 16 (Nov. 21), 35. Chem. Abstr., 1941, 35, 6056
and Shumskaya, T.
USE OF BUTTNER DRUMS FOR DRYING GRAIN AND MALT (transl. title.). The drums of Buttner malt grain driers can be used to dry wet grain or malt down to a moisture content of 11 to 14% in about 2 hours under mild conditions, with gas entering the drum at a temperature about 60°C and leaving at about 50°C.

Rice

142. Barger, E.L., Engler, K. Agric. Engng. St. Joseph, Mich., 1943, 24, and Thompson, A.H. 235
A FARM UNIT DRIER FOR COMBINED RICE. Gives a description of the design and operation of a farm unit drier for rice harvested with the combine. Rice drying and milling quality data, obtained as a result of one season's use of the drier, are tabulated.

143. Bodner, G. P. Agric.Eng.13,45-6,1932
OPERATION OF RICE DRYERS IN CALIFORNIA WITH LOW AIR TEMPERATURES.
 Principles of rice drying; features of Cerati rice dryer.
 Milling yields of rice may be increased from 55 to 75% by means of controlled air drying below 30°. Average good drying conditions being 82°F., 33% Rel.Hum.
144. Chiapelli, R. Riscultura, 1941,31,193.Chem.Zbl.,1942,
 1,2077
DRYING OF RICE (transl.title). When the artificial drying of rice was carried out in a stream of moving air at a temperature not higher than 35°C, no changes were observed in the germinating capacity of the rice.
145. Choudhury, D. K. J.Sci.Ind.Res.India.2(7)126 July 1949
 Mukharjee, B. K.
TREATMENT OF PADDY. Infra-red radiation reduces the period of drying to a considerable extent without lowering the vitamin value. the space required is also much smaller than for the usual practice of sun drying.
146. McNeal, Xzin Agric.Exp.Stn.Univ.of Arkansas College
 of Agriculture.Bull,487 June 1949.30pp.
ARTIFICIAL DRYING OF COMBINED RICE. 2 Diagrams of rice dryers, (experimental). Curves of drying times with drying temperatures. 10 Tables of results of drying at various temperatures. It was shewn that intermittent drying, up to 4 periods, with a rest in between each, shortened the total time of actual drying operation.

GREEN CROPS

Equipment General

147. ——— Agric.Eng.Rec.2 180-184 1948-9
GRASS DRYER TESTING.
148. Anon. Overseas Engineer 23 No.267 p.192
 Jan.1950
CROP DRYING. Pehrson Dryer. Loss of dry substance avoided. Temperature of crop does not rise higher than 60°C. Latest model to be known as P.751. Operation under negative air pressure. Output 18 cwt. dry matter per hour, at 35:1 water ratio, (80% H₂O). Each piece of chaff remains in the hot zone of furnace gases only 20 seconds as it contains sufficient moisture to guard against over heating.

149. ----

Farm Mechanisation Jan.Feb.Nov.Dec.1948
Jan.Feb.1949

DESCRIPTIONS AND COMPARISONS OF VARIOUS FARM DRYERS.

150. Anon. Gen.Electr.Review 53(1)p.34 Jan.1950
CROP DRYER. MULTIJET. Illustration of a dryer for most farm crops (grass to grains). Habco Manufacturing Co. Columbus (Nebr.) introduced the Jet-Dry crop dryer. Multijet air burner.
151. Anon. Sport and Country 19 April 1950 pp.320-1
A NEW GRASS DRYER. A diagram and 10 photographic illustrations of the TURBO grass dryer by Tiltman Langley; taken at the demonstration 31st March, 1950. Oil fired. Furnace can give 500,000 B.I.U. per hour. Dryer load, 2½ cwt., taking about 45 minutes to dry with recirculation and only just enough intake of air to burn the oil. Dry output about ½ cwt. with, one gallon of oil, stated performance.
152. Anon. Engineer 21 July 1950 170(4408)p.72
PORTABLE GRASS DRYER. Brief description of the Tiltman Langley "Turbo-Dryer" demonstrated at Redhill Airdrome 31.3.1950.
153. Anon. Gas J.1937.218.616-7 and Engng.1937 144
96-8
FURTHER DEVELOPMENTS IN GRASS-DRYING PLANT. Test figures relating to a Curtis grass drying plant equipped with a semi-producer furnace using coke, designed by the London and Counties Coke Association, are given.
154. ---- Penn.Agric.Exp.Stn.Penn.State Coll.Pa.
Bull.293 pp.12-13 1933
MECHANICAL HAY DRYER.
155. Anon. Coll.Guard.15/ 13 1938
Description of a new grass drying plant started on a Shropshire farm, of the Kaleroil type in which the final drying is in a revolving drum. The output is nearly five tons in 10 hours at a fuel consumption of about 48 cwt. of coke.
156. ---- Bureau of Pastures and Field Crops.
Aberystwyth March 1947
SURVEY OF GREEN CROP DRYERS.
157. Anon. Farmer and Stockbreeder 1939,53,1563
I.C.I. "MARK 3" GRASS DRYER. An illustrated description of a dryer installed at Llandovery (from I.C.I. Abstract).

159. Anon. Fert. & Feed. Stuffs J., 11/12/40, 25, 431
GRASS DRYING PLANT MARKETING. An essential feature of the
drying plant marketed by Messrs. Pratchitt Brothers Ltd., Denton
Iron Works, Carlisle, is the partial drying of the grass at high
temperature (5000°F.) on the elevator before the process is completed
in the actual drying chamber. In the latter the material is carried
backwards and forwards, falling from one band to the next below, and
being turned over each time; in this chamber the temperature is
maintained at about 200-2500°F. The double furnace can be either
coke or coal fired.
160. Ainsworth, C. M. B.P. 541,946 (December 18th, 1941). Brit.
chem, physiol. Abstr. B, I, 1942, p. 180
A DRIER OF LONG OR SHORT GRASS OR OTHER FORAGE. Describes equipment
for rapid drying of grass or similar crops for production of forage
in which a perforated or reticulated plate or screen is placed at a
suitable distance above the perforated or reticulated top of the
distributing duct of the drying chamber or cell, in order to obtain
a better distribution of heated air and/or gases.
161. Bowles, C. J. Minist. Agric., 1939, 45, 1093, 1100
GRASS AND CROP DRYING ON A YORKSHIRE MIXED FARM. Describes the
plan, operation and costs of a Kilmartin plant for the drying of
grasses and crops. The average cost of producing dried grass in 1937
was £3 5s. 6d. per ton.
162. Broek, W. van den B.P. 601,795/1948
ROTARY CYLINDER DRIERS. This relates to a cylinder drier of the
type having longitudinal flights and transverse baffle plates for
use in the drying of grass.
163. Cameron-Brown, C.A. Green Crop Dryers. Res. Assn. Year Book
83-4 - 1949
ELECTRICITY IN CROP DRYING.
164. Carr, R. G. B.P. 516,069 (December 21st 1939)
IMPROVED METHOD OF AND MEANS FOR DRYING GRASS. The method consists
in progressively subjecting the material (grass, etc.) in a closed
apparatus to a gaseous drying medium (e.g. hot air) of differing
degrees of dryness (between the almost saturated medium to which the
wet material is first subjected and the hot dry medium to which the
dried material is finally subjected before discharge), the moist
pressure of the drying medium being adjusted in intensity so as to
hold the material in suspension and against moving conveying
surfaces and to ensure the uniform transfer of material from one
section of the apparatus to another.

164. Cashmore, W. H. Agric.Engg.Record.2.79-80.1948
THE SMALL GRASS DRYER.
165. Cashmore, W. H. Chem.& Ind.,1943,62,278.
THE DRYING OF FARM CROPS. Discusses variations in quality and cost of production of dried grass and outlines the general principles of grass drying. Deals with 2 classes of drier, (1) counter-current, in which the hot air leaves at the end where the grass enters, e.g. conveyor or tray driers, and (2) co-current, where the air enters at the wet end and leaves at the discharge end, e.g. rotary and pneumatic driers. Requirements for a suitable grain drier are discussed and 2 methods of grain drying tried experimentally in the U.S.A., (1) heating in a sealed container and removing moisture by passing a stream of air through the grain and (2) the use of infra-red heating of grain passing along a conveyor, are noted. The importance of cooling dried grain to within 100°F of atmospheric temperature before storage is stressed.
166. Chartres, C. B. Proc.Inst.Brit.1948.Agric.Engrs.5:1-15
GRASS DRYING PLANTS.
167. Cheveley, S. W. Ivor Nicholson & Watson Ltd.127pp.1937.
6/- Nature 142 978.1938
GRASS DRYING. Reviewed in Nature.
168. Clyde, A. W. Agric.Engg.& Jnl.May 1933.
NEW DEVELOPMENTS IN HAY DRYERS. Data on the performance of a hot air dryer where the hay is passed on a conveyor (continuous) in the form of a regulated mat. (D.S.I.R. Library).
169. --- Commonwealth Bureau Aberyst.
List of 30 manufacturers of grass drying equipment.
170. Conacher, H. H. B.P.504,825 (May 2nd 1939)
IMPROVEMENTS IN APPARATUS FOR DRYING GRASS AND OTHER AGRICULTURAL CROPS. An apparatus for drying grass and other crops is provided with a perforated rotor ramp above the crop-drying zone of the apparatus, on which the crop is pre-dried by rising gases before loading into trays.
171. Dotterweich, F. H. Pet.Engr.19 176 Nov.1947
TRENDS IN THE DEHYDRATION OF AGRICULTURAL PRODUCTS USING GASEOUS FUELS.
172. Easterbrook, L. F. Prospect for the Land.C.O.I. Publ.1950
Photographs only (1) Mobile drying plant. (2) Milk Marketing Boards' drying plant for forty farms.

173. Ensink, N. V. B.P. 609,121 6.3.46 B.III.119.March 1949
Netherlands 7/1941
APPARATUS FOR DRYING GRASS. The grass (or other vegetable product with long stalks) is dried by leading it in the same direction as the drying gases through a stationary drum. The forward movement of the grass is effected by a rotating shaft, mounted eccentrically in the bottom of the drum, and provided with arms terminating in pronged forks which make an acute angle with the axis of the shaft.
174. Fulmer, J. H. B.P. 511,842 (August 25th 1939)
IMPROVEMENTS IN APPARATUS FOR DEHYDRATING GREEN FEEDAGE CROPS.
Claims apparatus containing superimposed conveyors, the forage material being fed to the uppermost conveyor and transferred from each conveyor to the one below it with the surface of the mass in contact with the lower portion of the conveyor above. The apparatus is characterized by means for passing heated air in direct vertical flow through several layers of material on and between the various conveyors and discharging the air from the top layer.
175. Goertz, F. A.E.G.Mitt. 1941, Nos. 1-2, p. 24
ELEKTRISCHE EINRICHTUNGEN FÜR NEUZEITLICHE GRÜNFUTTER-TRÖCKNUNGSANLAGEN. Gives an illustrated description of modern apparatus for drying green fodder, including drying kilns and band, rotary drum, belt, drum and spray driers, with special reference to electrical methods of operation. Equipment for the control of temperature and other drying conditions is dealt with.
176. Goodall, C. B.P. 609,768 21/3 1/4 & 24/5/1949
B.III.119.1949.March
APPARATUS FOR DRYING GRASS. Grass, leaves, etc, are supplied to one end of a jacketed compression chamber, which may be of gradually tapering form through which they are advanced by a reciprocating piston, or a rotary screw of progressively diminishing pitch, to a converging outlet consisting of a perforated plate or an assembly of resilient rods. Hot air is circulated in the jacket and in the hollow spindle of the screw.
177. Harrison, J. B.P. 501,730 (February 28th 1939)
IMPROVEMENTS IN OR RELATING TO APPARATUS FOR DRYING GRASS AND THE LIKE. Apparatus for drying grass, etc, comprises one or more end-to-end perforated conveyors mounted in a container to form a chamber into which is led hot air. As the grass is being discharged, cold air is prevented from entering the container except through the grass.

178. Harrison, J. B.P. 513,012 (October 2nd, 1939).
IMPROVEMENTS IN OR RELATING TO APPARATUS FOR DRYING GRASS OR THE LIKE. Describes apparatus in which the conveyor, or the lower conveyor of a series, projects through the end of the container for removal of the dried grass. Means associated with the upper and lower runs of the conveyor ensure that, while grass is being discharged, cold air is prevented from entering the container except through the grass.
179. Hine, H. J. Agric. (J. Min. of Agric.) 50(1) pp. 16-19
IN PREPARATION FOR GRASS DRYING. Getting equipment into good working order. Choice of Fuel. Machine Maintenance in Plant and Field. Servicing Systems.
180. Hixon, R.M., Bakke, A.L. J. Amer. Soc. Agron., 1939, 31, 428. Exp. Sta. Rec., 1939, 81, 428.
PORTABLE FIELD DRIER. Gives an illustrated description of the method of construction and operation of a portable field drier.
181. Hoodemaker, M. (B.P. 601,794/1948).
DRYING GRASS AND OTHER HERBAGE. Claim 1:- A device for drying grass and other herbage for cattle comprising a tubular drying channel provided at one end with an inlet opening for hot drying air or drying gases and for the material to be dried, and at the other end with a common outlet opening for the heating means and the dried material, characterized in that a portion of the tubular drying channel is of a helical shape and is rotatable about the axis of the screw line.
182. Hutchison, R. M. Pat. Engr. 19 96. Ap. 1948
CHALLENGE TO THE NATURAL GAS INDUSTRY. Its use in the drying of crops.
183. I.C.I. Summary of Papers Sth. Regional Meeting 21.1.48. 8 typed sheets incl. diagrams.
 1. Grass Conservation. A survey of the present position (U.S.W.). An assessment of the merits of various types of dryers. (Diagrams).
 2. Dryer Accessories. T.H.E. Inc. Field Equipment Handling. Power Units. (D.S.I.R. Library).
184. Jenny, H. B.P. 503,964. (April 18th, 1939).
IMPROVEMENTS IN OR RELATING TO METHODS OF AND MEANS FOR DRYING FODDER PLANTS. Describes an apparatus for drying grass by circulation of a mixture of combustion products and air through it. The hot gases and moisture are drawn from the drying chamber through conduits which heat fresh air. The heated air is then supplied partly as combustion air.

185. Kaloroil Burners, Ltd., B.P. 507,756 (June 16th, 1939).
Goldberg, A., Slade, R.E.
IMPROVED METHOD OF AIR APPARATUS FOR DRYING GRASS, FORAGE, CROPS, GRAIN AND THE LIKE. Grass and other vegetable material is dried in layers on a perforated tray through which hot air rises, the air resistance of the tray being about $\frac{1}{2}$ that of the grass and the air resistance of the tray and grass being about $\frac{1}{3}$ of the total resistance of the system.
186. Laudon, A. K.Landtbr Akad.Handl.Tidskr.,Stockh., 1940, 79, 193 (Summary in English).Chem. Abstr., 1940, 34, 8099.
TECHNICAL BASIS OF THE ARTIFICIAL DRYING OF FORAGE PLANTS (transl. title). 8 Types of drying apparatus are described. Artificial drying of young grazing crops can increase fodder productivity and digestible protein.
187. Lenz, E. H. West.Gas 8 21,61 (1932).
DEHYDRATING ALFALFA: NEW USE OF NATURAL GAS IN MISS.
Arnold Drier Co. Removing 8,000 lbs. water per hr. produces 4,000 lbs. dry hay per hr. with consumption of 12,000 cu.ft. natural gas.
188. McLeod, H. M. (U.S.P.2,397,363/1946).
DEHYDRATING PLANT FOR THE TREATMENT OF GRASS, PEAT AND OTHER MOIST SUBSTANCES. Dehydrator plant comprising in combination, a comminutor at the receiving end of the plant, endless conveyor means disposed at the delivery of the comminutor and adapted for taking a grip on material received from the comminutor, pressing means active upon the endless conveyor means at one point in its travel, heated drums supporting the endless conveyor means over a part of its further travel, a heating and drying chamber at the delivery end of the plant, transferring means disposed between the delivery of the endless conveyor means and the chamber and operative for transferring material from the conveyor means into the chamber and a source of heat connected up for supply of heat to the drums and chamber.
189. Maassen, W. Landw.Jo.1940, 90, 811.Chem. Zbl., 1941, 11, 1341.
DIE GRUNFUTTER-UND RUBENELATTROCKNUNG AUF DER LANDWIRTSCHAFTLICHEN DORRE. Gives an illustrated account of the construction of older and newer types of drier, the plan of a unit drier for fodder and its performance and use in operation, the cost of drying, etc.
190. Nat. Inst. of Agr. Enge. Publications and Reports 1950.
See under "AGRICULTURE GENERAL".

191. Newman, J.E., Kennedy, D.S. (B.P.577,483/1946).
APPARATUS FOR DRYING GRASSES AND THE LIKE. This invention relates to apparatus for drying grasses by means of hot air or flue gases from a furnace or other source, and more particularly to improved apparatus of the kind described in B.P.561,534.
192. Newman, J.E., Curtis, E.E. B.P.469,374.01.19.1939.
IMPROVEMENTS RELATING TO PLANT FOR DRYING GRASSES AND THE LIKE.
193. Pessell, R. C. B.P.502,895(March 21st, 1939)
IMPROVEMENTS IN MACHINERY FOR DRYING CROPS AND GRAIN, SEED, HAY AND THE LIKE. Apparatus for drying grass, crops and other vegetable material (including barley) comprises superposed steam-heated plates mounted on a stationary shaft carrying hubs with radial arms provided with stirrers or tines. The grass is fed to the uppermost plate by a conveyor and endless chains.
194. Rammler, E. et al Feuerungstech., 1938, 26, 241. Brit. chem. physiol. Abstr. B, 1938, p. 1495.
DRYING AND THERMAL TESTS WITH A SUSPENSION DRIER [FOR GREEN FODDER] (transl. title). A Rema-Rosin gas circulation drier for green fodder (lucerne and beet tops) is described. Experimental data, including power requirements and drying costs, are tabulated. One ton of protein in the fodder is obtained in exchange for 1.25 tons of bituminous coal or 5.85 tons of brown coal.
195. Rammler, E. Braunkohle, 1938, 37, 677.682. Brit. chem. physiol. Abstr. B, 1938, p. 1494.
ARTIFICIAL DRYING OF AGRICULTURAL PRODUCTS (transl. title). The artificial drying of green fodder is discussed from the economic aspect and details are tabulated of 2 tests with a Rotiner drier, in which water contents of lucerne and beet leaves, respectively, were reduced from 72 and 84% to 5 and 8%. In this plant the material passes once through a preliminary drying stage and is then continuously re-circulated in a second stage until the required degree of drying is reached. Combustion gases from a furnace burning brown coal form the drying agent. The heat consumption is given.
196. Roberts, E. J. London: H.M. Stat. Office 1937. Agric. Res. Council Rept. Series No. 2. 125 pp.
GRASS DRYING. (The furnaces, fuels, and principle types of machines used in grass-drying are discussed.
197. Roberts, C.H., Papps, R. B.P. 518,003 (February 16th, 1940). Brit. chem. physiol. Abstr. B, 1940, p. 489.
IMPROVEMENTS IN OR RELATING TO GRASS DRYING PLANT. In a drier operating with moderately heated air or waste gases, the grass is charged through side openings on to pivoted trays and from there dropped to lower trays, which can be slid out through other openings.

198. Simonsen, C. U.

B.P.605,505 27.12.45 Denmark 29.8.40

B.III.91 Feb.1949.

DRYING OF AGRICULTURAL AND HORTICULTURAL PRODUCTS. Hot gases entering one end of the inner of 2 co-axial-mounted perforated drums. Material in annular space. Partial recirculation of air.

199. Slade, R. E.

Green Crop Dryers Res.Assn.65-72 1949
Year Book.

GRASS DRYERS.

200. Slade, R. E.

Trans.Inst.Chem.Eng.1937,15,233-40.

DEVELOPMENT OF GRASS DRYING. (Work has been directed towards the design of a small unit, suitable for farmers, to avoid the cost of transport of the wet grass to a central factory, and at the present time high-protein dried grass can be produced at an overall cost of 28 per ton, which is lower than the equivalent price of imported foodstuffs. About 100 driers are in use in this country but the commercial types on sale are usually too large for the average farm. The type developed by Slade (of I. T. I. Ltd.) consists of a single fixed tray 18 ft. long, 7 ft. wide and 2.5 ft. deep. This is filled with grass to a depth of 2 ft., the charge being held down by a muddle covered with Hessian matting. Drying is carried out by furnace gases at 120°C. distributed by a fan, for 1.5 hr. During this process, the charge shrinks to half its original volume, and more grass is added, the heating being continued for another 1.5 hours. The grass is then turned over and heated for one hour more, after which time drying is complete. The average air cycle efficiency during the process is 7d per cent. and 7.6 kilos, of water are evaporated per kilo of coke burned.

201. Southwell, P. H.

World Crops 2 159-163 1950

GRASS DRYERS. THEIR CONSTRUCTION AND OPERATION.

202. Sybel, H. von

Techn.in d.Landw.,1938,19,131. Brit.chem.
physiol.Abstr.B,1939,p.208.

TECHNICAL PROCESSES FOR DRYING GREEN FODDER(transl.title). A review of equipment and technique.

203. Treloar, W. W.

B.P.532,829 of 9/9/1939:31/1/1941.

Brown Boveri.

DRYING APPARATUS. A method of drying materials (particularly agricultural products) by utilising the heat of a vapour evolved from the material, is characterised by the feature that the drying air after being brought in the first drying section to as high a dew point as the material will allow, by means of an external source of heat and the absorption of water, is passed practically saturated through heat-exchangers in at least one further drying section, and that there fresh air is driven over the heat-exchanging elements and through the material. Apparatus for carrying out this method

comprises at least two drying chambers through which the material passed, one of which has an external source of heat and the other(s) is (are) heated by heat-exchangers which are supplied with the air and vapour mixture. The machine is built in 6 ft. sections with a fan to each section. It is of simple construction, consisting of one endless conveyor belt which carries the material evenly upon a conveyor brattice, without attention from the operative. The feeder has a large storage hopper, and the rate of feed can be controlled to deposit a layer of material of the required thickness upon the conveyor. Insulation is effected by means of cork slabs enclosed between mild steel sheets, arranged as removable panels. The fans discharged the air into the drying chamber above the heating pipes. The heated air passes through the material lying on the brattice, and is afterwards returned to the fans for recirculation.

214. Weidall & Assembly, Ltd. Ind. Mach. Engr. 11, (49) 117, July 1948.
Farmac Dryer, a pneumatic, continuous crop dryer with twin oil burners. Evaporates 1 ton of water per hour at 30 galls. of oil per hour; capable of drying grass from 65% M. to 10% at 11 cwt. per hour output. Cost £1,800. Illustr.

Equipment Continental

205. ——— Dutch Directorate of Agriculture
Agric. Information Services 4 1948.
COMMERCIAL GRASS-DRYING CENTRES IN HOLLAND.
206. Anon. (Elektrizitätsverw. 1944-5, 19, 1-3).
ELECTRIC GRASS-DRYING IN SWITZERLAND. In the summer of 1944, 45 major installations totalling 31,100 kW and over 10 minor ovens (10-50 kW) were in operation. Grass for cattle should be 5-6 weeks old, for pigs and poultry 3-4 weeks. Spring and summer grass is of higher quality. Preliminary sun drying for some hours reduces water content and transforms ergosterine into active vitamin D, while A₁, B₁ and B₂-vitamin contents remain constant throughout the process. The temperature should not exceed 1100-12000, rising to 700C in the final stage. The end product contains about 10% water and further fermentation is inhibited. The working hours (1,500-2,000 p.a.) should be carefully distributed with regard to load conditions of the supply net to justify the low charge (0.02 FR. (KWH)). Various designs of oven were used and a detailed cost calculation for a 4-belt, 600 kW Brown Boveri unit is given with diagrams and tables, for different numbers of working hours. Application of a thermopump system seems possible. D.S.I.R. Library.

Stichting voor de Landbouw Commissie
voor Voeder an Weidebouw Uitgave van de
Directie van de Landbouw Maandblad voor
de Landbouw voorlichtingsdienst 5.4.133-
184 's Gravenhage. April 1948.

HET DROGEN VAN GRAS. A survey.

10 Jaar Grasdragen - Dr. Jr. H. J. Frankina 3pp.

Production - Jr. M. C. Hart 10pp.

Food Value of dried grass - Dr. N. D. Dijkstra 7pp.

Carotene value " " - Ir. S. Bosch 5pp.

Quality of " " - do. do. 3pp.

Drying of other fodders. - M. H. Huisman 10pp.

Technical and Financial Results of Grass Drying. 1947. Tables -
G. de Jong. J. L. B. Swart 9pp.

Large bibliography. (D.S.I.R. Library).

208. Jr. S. Bosch, Contr.

Div. v. d. Landbouwvoorlichtingsdienst.

Inst. voor Landb.

Mededeeling No. 48 1947 30pp.

Kundig Onderzoek te

Wageningen

HET KUNSTMATIG DROGEN VAN GRAS. Development, Technique, Equipment.

209. Bosch, Ir. S.

Directorie v. d. Landbouw. Landbouwvoor-

Deijs, W. B.

lichtingsdienst. Mededeeling No. 53. 1947.

HET CHEMISCH ONDERZOEK VAN GEWASSEN OF HET CENTRAL INSTITUT VOOR

LANDBOUW KUNDIG ONDERZOEK TO WAGENINGEN. 8pp. The Laboratory
methods are given for the chemical examination of fodders and fruit.
Tables of results.

210. Breirem, Knut

Grondahl & Sons, Oslo 1948.

KUNSTIG TORKNING AR GRAS. NORWAY. Mainly biological. Illustr.
Some physical aspects.

211. Brown Boveri & Co. Baden.

Pamphlet 1878F IV. 2. (X. 42) 5pp.

ELECTRICALLY-GENERATED HEAT IN THE SERVICE OF THE FOOD SUPPLY OF THE
COUNTRY. Brown Boveri Band Dryer with recuperation. Cost -
100,000 Swiss Francs. 250 Kg. of dry material per hour from 80%
moisture. Energy Consumption 600 Kcal per Kg. of water
evaporated 1,000 B.T.U. per lb. water. 30 - 40% of water eliminated
from the fodder is removed in the 1st drying stage and the heat for
this is drawn from recuperation. Performance is illustrated by
curves.

212. Chartres, C. B. and others (London: H.M.S.O., 1948, Agriculture Overseas Rep.No.7,22pp., 1/3).

REPORT OF THE BRITISH AGRICULTURAL MISSION TO THE MINISTRY OF AGRICULTURE AND FISHERIES AND AGRICULTURAL MECHANICAL DEVELOPMENT BOARD BY MEMBERS OF GRASS DRYING MISSION, A BRANCH OF INVESTIGATIONS IN HOLLAND, BELGIUM AND GERMANY, JUNE 1947. The objects of the mission were to find out what advances had been made in the design and operation of green crop driers, auxiliary drying plant and field equipment, to study the production of crops for drying and the methods of handling, marketing and feeding the dried product, and to examine the process of drying in relation to general farming practice. Of 11 different makes of drier seen, only the Van den Brock and the Svenska Maskfabriken, of pneumatic drum type, and the Pehrson, of pneumatic tower and drum type, appeared to offer possible advantages over existing British designs. The oil-fired furnace made by the Hesselator Company for use with their drier also appeared to be an improvement on furnaces used in Britain. Table of performance data.

213. Fremeryn, Jr. I. A. de Dept.V.Landbouw and Vischerij.Publicatie No.5.Gravenhage.

PROEVEN EN METINGEN AAN GRASDROGERS IN DEN ZOMER 1942.

- 214 Hohl, Pal, Min. of Agr. Abdruck aus dem Landwirtschaftlichen Jahrbuch der Schweiz.pp.75 - 95.1942.

DIE KUNSTLICHE GRAS TROCHNUNG. Electric Installations:-

- A. Drum Dryer by Buhler. Uswil.
 - B. Multiband Dryer with Recuperation by Brown Boveri. Baden.
 - C. Multiband Dryer without Recuperation by W. Gorman in Innsbruck
 - D. Single Band Dryer by Bucher-Guyer in Niederweningen
- Diagrams, illustrations, output data, costs and some chemical data, in German. Cost of 100 Kg. 3.20 - 3.50 Fr. Sw. incl. meal and pressing costs. D.S.I.R. Library.

215. Jong, G. de (Kort, J.L.L. Ministers van Landbouw, Vischerij and Voedselvoorziening.Directie van de Landbouw.Publicatie No.8 van de Commissie voor het Kunstmatig drogen van gras en andere raw voeders. Report for 1946.Gravenhage 1947. 23pp. and 8pp.

TECHNICAL AND FINANCIAL RESULTS OF GRASS DRYING IN 1946.

Appendix:- Cost prices of dried grass and import prices of feeds 8pp.

216. Milk Mktg. Board.
Thames Ditton.

GRASS DRYING IN HOLLAND REPORT July 1948

217. Pherson, A. P. (Fert. & Feed.Stuffs J.1939,24,301)
PARTIAL FIELD DRYING OF GRASS. Tests have been carried out in Denmark by the Torffo Co. for operating the Pherson Dual-Process type of driers. "In bright sunshine three hours of wilting cause a loss of about 25% of carotene and if it is blowing the loss is considerably accelerated. Wilting for a few hours in cloudy weather does not cause much damage." The Pherson Dual-Process Drier reduces the moisture content to 25-30% in a few seconds at high temperature, and completes the drying in a drum at low temperature. (From I.C.I.Abst.).

Process General

218. --- Hannah Dairy Res.Inst.Report to 1947
CONSERVATION BY ARTIFICIAL DRYING.
219. --- Inst.Agric.Engg.Bull No.2
 Clarendon Press.Oxford
PRELIMINARY REPORT OF AN INVESTIGATION INTO THE ARTIFICIAL DRYING OF CROPS IN THE STACK.
220. Anon. B.F.532,247 (January 23rd,1941). Brit.
 chem.physiol.Abstr.B,III,1941,p.106.
A METHOD OF PREPARING FOOD-STUFFS. Maamloose Vennootschap
 G. A. Scholten's Aardappelmeelfabrieken. Potatoes are comminuted, the juice is drained off and the residue is mixed with comminuted vegetable material (waste sugar beet, with or without tops and leaves, green fodders, etc). The product may then be dried for animal or human consumption.
221. Anon. (Gas J.,14 Jan.1948,Vol.253,105-106).
CO-OPERATIVE GRASS DRYING. A description of the Thornbury central grass-drying scheme, Gloucestershire, developed by the Milk Marketing Board in collaboration with Imperial Chemical Industries, Ltd.
222. --- Farm Implement News Mag.p.42.26 Sept.
 1946.
HAY HARVESTING FOR DEHYDRATION.
223. --- Year Book.1949 The Green Crop Dryers
 Research Asscn.Farmer's Weekly.
 28 Articles dealing with all aspects of grass drying, lists of members of the County Agricultural Executive Committees, the National Association and other land officers of the National Agricultural Advisory Service and much other information.
224. Anon. (Agricuilt.Engng.Rec.,Winter 1947-8,2,
 No.2,45-9).
GRASS DRYING. Problems which must be met before grass drying can become a large permanent source of general application relate to drying equipment, field and transport equipment, and systems and techniques by which the two can be linked. A few aspects of major obstacles to the evolution of a simple and efficient drier are dealt with. Grass driers must be able to deal with variations in

the raw materials including considerable variation in the moisture content of the crop as it comes from the field. The two stages by which drying takes place, by the evaporation of surface moisture and of intercellular water, are explained. Two types of British driers, tray and conveyor, are described. Driers employing a high initial air temperature which are used on the Continent are described; they are of two main types; pneumatic drum, and pneumatic tower and drum.

225. ---- Agric. and Industrial Dryers Ltd. 1949
Grass and Grain Drying in open trays, with use of a Heat Pump driven from a Fordson tractor engine, with further partial recovery of the engine exhaust heat. The vapour from the drying crop is passed over the expansion and compression coils of the heat pump respectively, and run out of the system as liquid water. Descriptive pamphlet from the firm.
226. Barr, H. T. Louisiana State University. Bull. No. 261
May 1935 14pp.
ARTIFICIAL DRYING OF FORAGE CROPS. General discussion on the process and advantage of artificial drying, and on what takes place in the grass from cutting, to final drying.
Diagrams:- Revolving drum dryer, Conveyor band dryer,
Ardrier = Passage of grass through triple cylinder.
10 Refs.
227. Bachtel, S.I., Clyde, A.W., Penn. State Coll. Bull. 300-30/1/1940
Cromer, C.O., 24 PP.
Williams, P.S.
DEHYDRATED AND SUN CURED HAY. Deals with various crops and effects of wilting and crushing. Comparisons of feeding values of product by the two processes. Illustrations of dryers and crusher.
D.S.I.R. Library.
228. Becker, M. J. Landw., 1939, 86, 249. Chem. Abstr. 1939,
33, 7918. Biol. Abstr., 1940, 14, 509. Nutrit.
Abstr. Rev., 1940, 9, 875.
HERSTELLUNG, BEFERTIGUNG UND ANWENDUNG VON KUNSTLICH GETROCKNETEN GRÜNFUTTERN. MIT VERGLEICH MIT DEN BEI DER VORBEREITUNG DES GRÜNFUTTERS AUFTRETENDE VERÄNDERUNGEN. Discusses the principles of artificial drying with drum-kiln and rotary driers of crops and green and immature, e.g. beet tops, alfalfa, wheat clover, other legumes and potato tops, and summarizes results of feeding experiments. Gives results of an experiment in which protein, nitrogen fractions, water, sand, ash, cellulose and pectin contents of beet leaves, before and after washing, pressing and chopping, and of the expressed liquid were determined. It is pointed out that vitamins A and B, largely lost in natural drying, are mostly conserved by artificial drying. Comparisons are made of the value

of the products prepared by several methods, and the generally improved feeding value, as compared with that of naturally dried feeding-stuffs, is emphasized.

229. Belt, N. O. Agric. Engng. St. Joseph, Mich., 1942, 23, 257.
THE DRYING OF YOUNG GRASSES FOR FEED. Describes features of driers for young grass, including the Forden drier (on the Hillingham principle), a low temperature drier, operating between 150° and 300° F (122.3° and 149° C), in which grass is loaded in 2 movable trays and gases from an oil-fired furnace are drawn through it, and another Hillingham type and the Fendy whirlwind drier, which operates at much higher temperatures, an apron or conveyor type (formerly used to dry cotton) and a triple-drum rotary drier. High temperature drying is considered to be more economical and to produce as good or even a better product than low temperature drying. Dried immature pasture herbage makes a feed of superior quality and can be grown and dried on a farm scale. Cutting and loading machinery should be developed further and the tagging, baling and storage of dehydrated crops need study and improvement.
230. Barchtold, Ing. M. Electricitäts Verwertung Vol. 19. 1944/5 pp. 56-8
Int. f. Thermodyn. Zurich.
DRYING WITH THE HEAT PUMP. Theoretical considerations and performance in drying by means of a heat pump. The method is by reducing the pressure of the exit moist air, whereby the water is precipitated as a mist. This is separated by a turbine and the dryer air recompressed and used again. Cost comparisons with conventional dryers are given which are favourable to the heat pump installation owing to the very high price of coal in Switzerland.
231. Blackburn Corp. Farmers Weekly p. 28. 11. 3. 49.
Powell, F. V. (Engr.)
GRASS DRYING WITH FLUORINE GAS. Blackburn Corporation plans to dry grass with waste sludge gas at Salnesbury. Est. 80,000 a.ft. of gas daily could dry 700 tons annually at £12 3s. 0d. a ton. Charges etc. should be paid off in 10 years. Annual saving in fuel oil would be 170 tons, value £1,430. The deterioration of the sludge irrigated land will thus be remedied and reversed. Full account in Jnl. of Roy San. Inst., 69 No. 3 194-203. May 1949. No details of grass drying plant.
232. Botha, J. P. Fmg S. Afr., 1941, 16, 291
A USEFUL TACK FOR DRYING GRASS. A simple wooden frame is used. Hay is stacked on the platform and round the 4 legs above the platform, leaving an air-space in the middle of the stack. It is claimed that mould growth can thus be prevented in damp weather.

233. Cheveley, S. W. (Coke 1940,2,51-2,64).
GRASS DRYING AND ITS RELATION TO THE COKE INDUSTRY. A descriptive account, preceded by a short historical summary.
234. Dyckerhoff, H. I. Mitt.Landw.51.940-1.1936(in German)
ARTIFICIAL DRYING OF GREEN FODDER PLANTS.
235. Ellis, E.M., Weaver, J.W. N.Carolina Univ.State Coll.of Agric. and Engg.Extension Circular.
DRYING CROPS IN A FLUE TOBACCO BARN. Quoted in "Scientific Agriculture", Canada. Jan. 1949, 29. No. 1.
236. Emerson, A. W. Farm Implement News pp.42-45.
 26 Sept.1946.
HAY HARVESTING FOR DEHYDRATION. A description of harvesting, and data about production and food value of alfalfa.
237. Fairclough, D. Fuel and the Fatiere 1948. p.337-9.
GRASS AND HERB DRYING. General considerations in grass drying, and the operation of grass dryers. Fuel Costs and Furnace and Dryer efficiency. Raw material and wilting. Barn drying (superhay) Herb drying.
238. Foster, R. F. (Butane Propane News, Oct.1946,8,No.10, 21-26).
PROCESSING ALFALFA WITH BUTANE. Two plants near Bearno, Texas, use 7,000 gals. of butane daily during the drying season, delivered twice daily by truck from a plant 100 miles away. Each plant has a dehydrating oven 3 ft. in diameter and 3 ft. long, using vaporized gas at the rate of 12,000,000 B.t.u./hr. and a 350 h.p. butane engine requiring 3,000,000 B.t.u./hr. Advantages of the process include:- reduction of labour costs, increase in yield/acre, distribution of harvesting over longer period, continuous growth, retention of 95.5% carotene content compared with 85.8% by slow sun-curing, since rapid evaporation of moisture gives low product temperature in the drying drum. Between 800 and 1,200 acres are taken care of during the year and crops can be cut and processed in the same day. The process is described. Leaves are dried and drawn in 20 to 30 seconds, stems in 3 to 5 minutes and meal is stacked according to grade. 25 tons of meal are produced per day.
239. Goldberg, A., Bartelli, A.C. Trans.Inst.Chem.Engrs.22,p.89-96
 Paper 14, Nov.1944.
GRASS DRYING, ENGINEERING ASPECTS. The peculiarities of grass and their influence on dryer design. Temperatures vs. losses for scorching. Rates of evaporation. R.H. Equilibrium curves. Variation of Sp.Heat with Water Ratio. Heat transfer. Heat sensitivity. Milling. Drying cycles. Diagrams showing air flow for all main types of dryer. Illustrations of furnaces. A very informative paper. 13 References.

THE EFFECT OF CLIPPING AND DRYING IMMATURE GRASSES ON THEIR YIELD AND CHEMICAL COMPOSITION. Describes a process of drying immature grass, using a 1-tray batch drier, heated by an oil burner and provided with a fan to draw hot gases first through a tray of partly dried grass and then through another layer of fresh grass, the moisture content of herbage in the partly dried tray being reduced below 10%. The product retained its original green colour. A study of yield and chemical composition indicated that it was possible to produce a good yield of a feeding-stuff with high protein and carotene and low fibre contents from a grass and clover mixture, and that the feeding-stuff could be well preserved by artificial drying, followed by storage in bales.

ARTIFICIAL DRYING OF GREEN FORAGE CROPS. IV. TECHNIQUE OF ARTIFICIAL DRYING OF GREEN FORAGE. Describes methods used in the mowing and transport of herbage, the construction of dryers for green forage and the drying process. Gives details of different types of dryer for green herbage, i.e. tray, band, drum and pneumatic dryers, with a brief note on the grinding and compression of dried herbage.

FIELD FOR CROP DRYING. Performance, and output of product.

USE OF BITUMINOUS COAL IN THE DEHYDRATION OF ALFALFA AND OTHER FORAGE CROPS. (Several manufacturers of dehydrators have shown that bituminous coal, fired by stokers, is a suitable fuel for the dehydration of forage crops. The coal is so completely burned by proper mechanical firing that the hay is not tainted. The total annual cost of heating, etc. including capital charges, fuel maintenance, labour and power, will be less with bituminous coal than with other fuels at prices that are current at many dehydrating plants. Complete cost calculations are given for various fuels.)
25 Rep. D.S.I.R. Library.

STACK FINISHING OF BALED HAY, WITH AND WITHOUT HEAT. Baled hay at 475 M. could not be dried even with heated air; at 300 M. it was successfully dried. Bales should be loosely tied.

247. Koeniger, W., Beuth Verlag.Berlin.(R.K.T.L 25) 1931.
Häuser, W.
DIE KUNSTLICHE GRÜNFUTTER TROCKNUNG. (Artificial Drying of Green Crops) (1) Technical (2) Agricultural.
248. Lambert, H. G. J.Min.Agric.56,103-6 1949.
COMMUNAL GRASS DRYING IN ENGLAND AND WALES. A brief outline of the work of 12 communal grass drying centres, since 1949. Cost £11.10. £23 per ton (Herbage Abstr. 20 (2) 483 May 1950).
247. Lewis, W., Eden, A. J.Min.Agric.56,12-15 1949.N.A.A.S.Cambr.
HIGH QUALITY DRIED GRASS. Results obtained in a mixed conservation policy.
248. Mackintosh, F., Yeo, M.L. Comm.Bur. of Pastures and Field Crops.
Memorandum.1949.
SOME ASPECTS OF GRASS DRYING IN GREAT BRITAIN.
249. McNair, J. Fowler, A.B. Hannah Dairy Res.Inst.,Kirkhill,Ayr,
Bull.No.8,1942.
THE PRODUCTION OF ARTIFICIALLY DRIED GRASS. Sections of the report deal with (1) the capital involved in grass drying, (2) production of the wet herbage, (3) cutting, collecting and delivering grass to the drier, (4) the operation of drying plants and (5) working costs and the return. Results of plot experiments are described in an appendix. Grinding and Baling. 33 Rep.
250. Melan, H. (Elektrotech.u.Maschinenb.(EuM),May-June
1947,64,65-70).
QUESTION OF ARTIFICIAL DRYING OF GRASS AND VEGETABLES. Data and formulae are given for the calculation of energy requirements of electrically-operated dryers, and a numerical example is included. Performance data from Swiss installations are cited. Alternative lay-outs of apparatus are illustrated.
251. ----- Milk Marketing Board
CO-OPERATIVE GRASS DRYING IN PASTURE PRACTICE. A survey carried out in March and April 1949: (Supp). The importance of dried grass is stressed and its relation to the health of cows and abundance in feeding methods are given. (Herbage Abstr. 20 (2) 484. May 1950).
252. Mitchell, F. S. Agriculture 57(1)9 and 10.April 1950
THE ENGINEERING ASPECTS OF GRASS DRYING. A comparison between high Temp. and low Temp. grass dryers. Claims that high temperature leads to an increased thermal efficiency have not been borne out by experience. Figures for various dryers have been quoted as from 40 lb. to 100 lb. water evaporated per gallon of oil. High temps. (pneumatic) have no appreciable effect on the digestibility of

protein as compared with that in the wet material. No evidence, when equal capacity is compared, to show that greater output per hour is obtained from a high temperature dryer.

253. Roberts, E. J.

Rep.Ser.agric.Res.Coun., Lond., No.5,
1939. Dairy Sci.Abstr., 1939, 1, 207. Exp.
Sta.Rec., 1940, 82, 176.

FUELS CONSERVATION WITH SPECIAL REFERENCE TO GRASS DRYING. Deals with grass drying in Great Britain and other countries, machines and equipment, production cost and feeding value of dried grass, partial field drying, drying compared with other methods of conserving grass and the artificial drying of potatoes, root crops and sugar beet tops. See also reports of Agricultural Res. Council for 1935-1937.

254. Roberts, E. J., Tester, L. G.

J.Min.Agric.Sci., 430-32 Jan. 1949.

HAY-MAKING AND GRASS DRYING SURVEYS. Methods of haymaking and grass drying are reviewed and their relative costs and efficiencies compared. Wilting reduced the water ratio from 3.2:1 to 1.6:1 resulting in an increased output of 1.9 cwt./hour and a decrease in coke consumption of 5.5 cwt. per ton of dried material. Discusses the nature of handling and labour required.

255. Sambrook, K. H.

(Fuel and Future, Ministry of Fuel and
Power, 1, 295-299; London: H.M.S.O.,
1948).

USE OF OIL FUEL FOR DRYING. The author discusses briefly the advantages to be obtained from the use of oil as fuel for drying, notably in the food stuffs and agricultural industries. These are the ability to regulate exactly the input of heat and temperature of the drying medium, if fired under semi or fully automatic control; if the oil is burned in a properly designed furnace, combustion can be so complete that the products of combustion are innocuous and, after mixing with the necessary quantity of air to produce the temperature required, may be passed directly through the material to be dried, which may easily result in a saving of 25 per cent. in fuel consumption. The safeguards generally provided are a high-pressure valve or similar device to cut off the fuel instantly in the case of any failure or abnormal drop in pressure of the supply of atomising air to the burner, and a thermostat or preferably a light sensitive device to cut off the oil instantly should the flame be extinguished. The fact that oil fired direct mixing dryers have been used for years in preparing high grade tea in Ceylon shows that there is little risk of contamination by the products of combustion of oil fuel.

256. Sambrook, K. H.

(Pap.to Joint Conf.,Insts.Petrol.and Fuel,
on Modern Applications of Liquid Fuels,
Sept.1948; B'han.: The Insts.,1948;
advance copy,19pp.).

FUEL IN GRASS DRYING WITH PARTICULAR REFERENCE TO LIQUID FUELS. It is demonstrated that the most effective and practical method of reducing the fuel requirements for drying grass would be the reduction in moisture content of the wet grass by a degree of wilting in the field. A review of air drying cycles employed in grass driers indicates that there is little difference in thermal efficiency between low temperature machines employing re-circulation and high temperature pneumatic driers and that the choice between the different types of machines may be based chiefly on the operating conditions and the form of product desired. A comparison of theoretical and actual fuel consumptions indicates reasonably low heat losses in more expensive driers, but attention is drawn to the importance of good insulation and avoidance of air leakage. Consideration of the possibilities of driers employing heat exchangers or heat pumps with important savings in heat requirements showed that there are disadvantages and complications which retard the prospects of their adoption except possibly where cheap electrical energy is available. The direct mixing air heater is discussed and reference is made to the advantages of liquid fuel for this application. Summary in Industr.Heat.Enr.2.30.1948.

256a. Turpin, E. R.

J.Min.Agric.57 79-82.1950

LARGE SCALE GRASS DRYING ON RECLAIMED HEAT. Grasses, cereals, lucerne and kale have been dried satisfactorily, but the difficulties with beet tops have yet to be overcome.

257. Scott, A. W.

Fuel and the future 1948 pp.340-4

ENGINEERING ASPECTS OF GRASS DRYING. (1) A brief review of the engineering problems in grass drying (2) some research work on the subject (3) economy in fuel consumption. Variation in moisture content. Standard performance for dryers. Types of dryers, "Forced Wilting", Utilisation of waste heat, e.g., from a brick kiln. Suggested need for "regenerative dryers", not yet built commercially, where latent heat could be recovered from the evaporated water.

258. Scott, A. W. J.roy.tech.Coll.Glasgow,1940,4,725.
TEMPERATURE EFFECTS IN GRASS DRYING. A new experimental plant for investigation of grass drying problems is described. Experiments showed that (1) the efficiency of a carefully designed low-temperature mat drier (in which heated air is passed up through a stationary mat of grass) need not be appreciably less than that of a high-temperature pneumatic drier, (2) for a mat drier the limiting temperature at which uniform drying can be obtained without severe local scorching is in the region 300⁰ to 350⁰F(145.H⁰ to 177.7⁰C), and (3) the rate of evaporation with fresh wet grass is much greater than with grass of lower moisture content, and advantage could be taken of this fact by employing atmospheric air to evaporate the initial moisture in very wet grass. A series of curves illustrated the relations between the variables investigated.
259. Ward, H. H. Milling.115 488 1950
THE NUTRITIVE VALUE OF GRASS AND ITS USE IN COMPOUNDS.
260. Walley, P. P. Fert.and Feeding Stuff. 1939.24,96.
GRASS DRYING. An account of grass drying experience during 1939 is given. The cost was 13/8 per ton of dried grass for coal; and the total electricity bill was about £50, it covered grinding into grass meal at about 100 tons. It is stated "grass drying is quite economical once the capital expense has been met".
261. Watkins, J. S. J.Brit.Grassland Soc.5 37-46 1950.
 Hamilton, R. A.
GREEN CROP DRYING IN U.S.A.
262. Watson, S. J. Scot.J.Agric.,1940,23,16.
ENSTALAGE AND GRASS DRYING. Discusses the production and use of artificially dried grassland herbage and ensiled young grass.
263. Watson, S. J. J.Sci.of Food and Agric.1(11)317-322.
 Nov.1950.
GRASS AS A SOURCE OF ANIMAL FEEDING STUFFS. This paper deals comprehensively with the economics and management of grassland. A list of 64 literature references is given in support of the various reports dealt with:- pasture yields, effects of frequency of cutting on total dry matter and protein content, seasonal productivity, and use of fertilizers.

268. Anon. Times Review of Industry May 1950
MODERN GRASS AND CROP DRYING PRACTICE. When Dr. R. E. Woodman of Cambridge published his original researches in 1938, British farming made a mistake in designing for a low output of 4 cwt. an hour and did not take into account possibilities of drying other crops. Majority of driers are now the horizontal conveyor type and a few are rotary drums (prechopped). Oil fuel allows control and reduces cost. Latest models give 12 lb. of moisture to 1 lb. oil but commonly 3:1. 1948, total production of dried grass was 110,000 tons and hoped for half million tons by 1955 with Government grants. Prices £400 to £2,000. The smallest dryer gives 4 tons a week and suitable for a 20 cow farm. Pehrson dryer will be sponsored and marketed, and reversed, the Aldersley grain dryer will be marketed in Sweden). Aldersley-Pehrson 1,700 0.11/1hr. 1/20 at 15 cwt./hour; 10 cwt. fuel will give 1 ton of dry material. New design for this country. Blow in air at 1,500 - 2,000°F without danger. Grass at 140°F + outlet air at 265°F. A rotary drum at much lower heat completes the drying.

270. ----

Farmers Weekly p.29.11.349

BIG BUSINESS. £2 million for 15 factories for drying lucerne, sainfoin, grass, sugar beet tops, kale etc. First meeting of farmers in Bury St. Edmunds is announced.

271. ----

Penn.Agric.Exp.Stn.Penn.State Coll.Bull.
293 pp.12-13.1933

MECHANICAL HAY DRYER. In 1931, 78% of the heat from the fuel was used in the drying. In 1933 67% was used, mainly by using a hotter fire and reducing circulation of air through the machine. Large saving of fuel made by wilting.

272. Adloff, K.

Wärme 1938.61.627-30

DRYING GREEN FODDER. Green fodder drying conditions in England and Germany are compared; the effect of artificial drying on the value of the fodder and costs of drying are discussed, and some dryers and a new drying process are described.

273. Burrell, J. H.

Chemurgic Digest 8(6)28-9 June 1949

Ralston Purina Co.

FACTORS IN ALFALFA FOR CHEMURGY. The Husbandry and Drying of alfalfa is related to losses of protein, carotene and feeding value. The need for greater appreciation of the value of alfalfa.

274. Fairclough, D.

Trans.Inst.Chem.Engrs.22, 97-102 1944

Discussion 102-109

GRASS DRYING - THE VIEW POINT OF THE FARMER. Yields of Protein and Carotene at various times of cutting. Husbandry. Farming and feeding aspects. The discussion deals with all production aspects including some information on dryer management. Recommendations.

275. Hanck, A.

Int.Rev.Agric., Mon.Bull.agric.Sci.Pract,
1941, 32, 218T. Chem.Zbl., 1942, 1, 124.

ARTIFICIAL DRYING OF GREEN FORAGE CROPS. II. THE PRODUCTION OF YOUNG GRASS AND OTHER GREEN FORAGE CROPS WITH A VIEW TO ARTIFICIAL DRYING. Deal with the composition of young grass and its production and factors which affect yield and quality, i.e. frequency of cutting, proportion of stems to leaves, fertilizers, weather, seasonal variations in growth and botanical composition. Cultivation of temporary pastures for artificial drying, the frequency of cutting, regimes for drying and requirements for the production of other forage crops for drying purposes are considered also.

276. Ingild, John A.

Visit to Holland, Denmark and Sweden.

Milk Marketing Board

Report 5 July 1948

THE PRODUCTION AND CONSERVATION OF GRASS IN THESE COUNTRIES AND A STUDY OF DEVELOPMENTS IN GRASS DRYING. Mainly concerning the summary of all methods of grass conservation including drying.

277. Hanck, E. Int.Rev.Agric.,Mon.Bull.agric.Sci.Pract., 1941, 32, 232T. Chem.Zbl., 1942, 1, 124
ARTIFICIAL DRYING OF GREEN FORAGE CROPS. III. ARTIFICIAL DRYING AND OTHER METHODS OF CONSERVING GREEN FORAGE. Discusses variations in production and system of working, relative losses incurred in hay-making, ensilage and artificial drying, and fodders obtained and the requirements of animal production.
278. Johnstone-Wallace, D. B. Green Crop.Driers Res.Assn Yearbook p.54 1949
PRODUCT FROM FRESHLY SEEDD AMERICAN FARM. 1939, 1940, 1941 were 2, 4 and 3 tons of dry matter respectively in 5 cuts containing 17-21% protein.
279. Lambert, H. G. Agriculture 56(3)103-6 June 1949
 Min. of Agr.
COMMUNAL GRASS DRYING IN ENGLAND AND WALES. Results for 1948. Data on throughput and on Protein contents for various sizes of driers.
280. Lewis, W., Eden, A. Agriculture J.Min.Agric.56 No. 1. Apr.1949 pp.12-15
 Nat.Agrl.Adv.Serv.Cambr.
HIGH QUALITY DRIED GRASS. Value of Finished Product based on various crude protein contents. Lbs. per gallon of milk - production for drying. Practical results with a mixed conservation policy. A very good treatment of the various considerations affecting grass conservation and results.
281. Slade, R. E. Times Survey of Br.Agric.Oct.1950 p.3
GRASS DRYING ON THE FARM. A brief review of the economic advantages of grass drying, of costs and prospects. Cost of drying £12 - 18 per ton including cutting, carrying and rolling. Cost of growing = £5 per ton (dry) of high protein-grass. Grinding and cubing = £6 a ton.
 1948 - 110,000 tons dry grass
 1951 expected - 350,000 tons dry grass
 1952 " - 500,000 " " "

Barn Drying

282. Bruin, H. D. Agricult.Engng, May 1947, 28, 202-204, 207
FLOW OF AIR THROUGH CHOPPED HAY IN MOW DRIERS.
283. Darling, C. S. Ind.Heat and Vent.Engr.11(50)212-214. Nov.1949
DRYING PLANT IN AGRICULTURAL ENGINEERING. This describes the construction of a barn dryer; notes costs of barn drying in dollars. $\frac{1}{3}$ of cost is depreciation. Almost equal is power cost.

SUPPLEMENTAL HEAT IN MOW DRYING OF HAY. Loading Conditions, Drying Times, Fuel and Power Consumption and Quality Results. Supplemental heat pays in respect of quality and insurance against damp climate.

COMPARISON OF DIGESTION COEFFICIENTS OF SUN CURED AND BARN CURED HAYE FROM THE SAME FIELD. Barn cured hay contained more crude protein, the sun cured, more crude fibre.

ELECTRIC HEATING FOR AGRICULTURE AND HORTICULTURE. A short review of cool air drying of grain and hay by electric means. American Practice - Housed and blown after 1 day wilting. Swedish Practice Immediate blowing 3 day total.

BARN HAY DRYING. These reports describe investigations carried out during the 1945, 1946 and 1947 seasons into the American technique of mow drying, and give details of the decentralised installations and the results obtained. The author's conclusions are set out, together with suggestions for applying the process to British farming. The appendices (W/T 17a) contain recommendations for the construction and operation of full scale installations that can be housed in new or existing buildings.

SUPPLEMENTAL HEAT IN THE MOW DRYING OF HAY. Parts I and II Curves and Data are given for the effects on drying rates of supplemental heat, and costs. Part II correlates the data on all the variables. D.S.I.R. Library.

THE APPLICATION OF BARN HAY DRYING. The paper sets forth the advantages of barn drying in preventing protein loss. (Horticulture Abstract 20 (2) 474. May 1950). J. Min. Agric. 55 348. 1948.

290. Grunder, M. S. Science. 91 299 1940 Biol. Abstr. 15 509, 1941
HAY VENTILATION. Reports that the principle of chimney ventilation was applied successfully to stacks of under-cured hay, in preliminary experiments made with the object of preventing, by naturally induced ventilation, excessive heating of under-cured hay in storage during the summer and autumn.
291. Hendrix, A. T. Agric. Engng. Sept. 1945; Heat. Vent. Dec. 1945, 42, No. 12, 98
FORCED AIR DRIES HAY. Tests were run on a hay mow 16 ft. square and 12 ft. high with a slatted floor under which was a plenum chamber 10 ft. square by 3 ft. deep. A centrifugal blower introduced air at controlled velocities into the chamber; and instruments for measuring temperature, pressure, moisture content, etc., were spaced to control the experiment accurately. Alfalfa hay of 81% moisture content was placed in the mow which was filled to a depth of 12 ft. (5650 lb. of hay). The fan was operated to supply about 20 cfm. per sq. ft. of mow floor continuously except for an "off" period of 4 hr. from 5 a.m. to 9 a.m. daily. During the drying period, mean relative humidity of the air was 70%. Twelve days were required to reduce the moisture content of the hay to a safe storage content of 20%.
292. Hendrix, A. T. Agric. Eng. g. 26 369-371, 1945. Exp. Stn. Rec. 94 265. 1946
HAY DRYING AND RESISTANCE TO AIR FLOW. Studies of air flow through hay, the static pressure necessary, made in an experimental storage barn. Results indicate that the static pressure required to effect a given volume of air flow is more than doubled for each 3 feet increase of hay depth above 6 feet.
293. Hudson, W. E. Agric. Engng. St. Joseph. Mich. 1941, 22, 170
STUDIES OF BARN-DRIED HAY. Describes tests with a barn hay-drying system. Barn-dried hay was found to be superior in colour, quality and nutritive value to field-dried hay.
294. King, W.A., Wilbur, J.W., J. Dairy Sci. 31 687 1948
Hauge, S.M. Cooper A.W.
STUDIES IN MOW-CURING OF Baled HAY. Drying in unheated air; the hay did not retain sufficient carotene.
295. Koontz, L.I., Mitchell, N., Agric. Engng. St. Joseph. Mich., 1941, 24,
Dickerson, W.H. Jnr. 419.
SOME RESULTS OF CURING HAY IN THE MOW WITH FORCED VENTILATION.
Discusses the use of the forced ventilation method of curing hay in Virginia, with the advantages being (1) elimination of the burning of field curing in a humid climate, (2) production of hay of higher quality, (3) reduction of handling and labour requirements, (4) increase in mow capacity, thus minimizing the storage problem, and (5) suitability for large or small farms.

VERSUCHE ÜBER STABILE FERMENTING. Describes experiments on the barn-drying of hay. When this process is used in the high mountains, the water content of the hay is often only reduced to 35%, so that intense and long-continued fermentation sets in. This decreased the digestibility of the crude protein and nitrogen-free extract. The higher the water content, the greater were the losses during storage. Carotene was not affected by short fermentations (temperatures not above 50°C), but with longer fermentations (temperatures over 70°C) it was almost completely destroyed. The barn-drying of hay is similar to warm ensilage. It is preferable to dry hay completely or ensile it at low temperatures.

DRYING HAY WITH FORCED VENTILATION. Gives details of construction and installation of equipment used for a study of the drying of partially cured hay in the mow with forced natural air ventilation. Observations were made in 4 barns in which this system of hay drying was installed.

MOW CURING OF HAY. A progress report. In tests described, partially cured hay was placed in a storage structure mounted on a platform scale and the blower was automatically controlled to operate (1) when spontaneous heating occurred in the mass of the hay and (2) when the relative humidity of the outside air was sufficiently low to afford suitable drying conditions. Measurements were made of air flow, temperature, moisture, time of operation and power consumed and results are tabulated.

COMPARISON OF BARN-CURED AND FIELD CURED ALFALFA HAY. Barn cured hay resulted in larger yields of milk, contained 60% more carotene after storage and was leafier than field cured hay.

A SUMMARY OF BARN HAY CURING WORK. Deals with a system for the barn drying of hay, which consists of specially constructed wooden air ducts on the hay mow floor. The method of curing and automatic control of curing equipment are described. Barn-cured hay was found to contain 4 times more carotene than field-cured hay. An account is given of the development of the barn-curing system on farms.

301. Schoenleben, L. G. Agric. Res. Admin. U.S. Dept. Agric. Bull.
Davis, Roy B. No. 78. 8pp. April 1947
MOW DRIED HAY. Principles of operation, construction of floors and ducts, illustrations. Amounts of labour for and conditions of drying. Quality results tabulated. Comparisons with silaged hay. A list of 9 American Institutions which have published information on mow drying is given. D.S.I.R. Library.
302. Schoenleben, L. G. Agricult. Engng. May 1947, 18, 195-196, 201.
Shepherd, J. B.
EFFECT OF MOISTURE CONTENT ON DRYING REQUIREMENTS AND NUTRIENT LOSSES IN CHOPPED FORAGE DRIED ON MOW HAY FINISHERS. A report on work done as part of an extensive forage harvesting research programme of the U.S. Dept. of Agriculture. Tests were made to determine the effect of a high and a low-moisture content on the time required to dry to a safe moisture content for storage, the blower and electricity requirements for drying, the chemical composition of the forages produced and the losses of dry matter and feed nutrients sustained. The forage used consisted of third cutting mixed alfalfa, ladino clover and grass.
303. Sjogren, J. W. Agric. Engng. St. Joseph, Mich., 1941, 22, 219
Rodgers, P. D.
RESULTS OF BARN HAY-DRYING STUDIES. A report of tests to examine the operation and cost of 2 barn hay-driers, operating with and without the use of supplementary heat.
304. Stere, J. B. Agric. Engng. St. Joseph, Mich., 1943, 24, 186
MOW CURING OF PARTLY CURED HAY. A note on results obtained on a dairy farm in Pennsylvania, equipped for the mow curing of partially field-cured long hay by forced ventilation. Among the advantages claimed are (1) reduction in the risk of fire, since the hay is cooled in the process, and (2) improvement in quality, since storage was possible without undue bleaching.
305. Terry, C. W. Agric. Engng. St. Joseph, Mich. 29, 208. 1948
SOME 1947 RESULTS OF BARN HAY DRYING RESEARCH. RESPIRATION. In cool air of high R.H. and moving slowly, a larger proportion of the heat of evaporation comes from respiration than with opposite conditions. Illustrated by graphs.
306. Ulvaek, -S. Ugeskr. Landm. 95, 67-70 1950
DRYING HAY IN THE BARN. Advocates investigation of this method in Denmark. (Herbage Abstr. 20 (2) 475 May 1950).
307. Weber, J.W. Jr., White, C.E. Tennessee Agric. Exp. Sta. Bull.
No. 170, 1939. Exp. Sta. Rec. 1940,
82, 398.
DRYING HAY IN THE BARN AND TESTING ITS FEEDING VALUE. Discusses briefly previous devices for drying and estimating moisture

construction and operation of a satisfactory barn-drying system, which was developed on the basis of the observation that the moisture content of hay falls from about 75% to about 45% in the first 4 to 6 hours of field drying on clear days. A barn drier is then capable of removing approximately 28% more moisture with economically practicable efficiency. Drying from 45% to 15% moisture required from 4 days to 2 weeks, according to weather conditions and quantity of hay. Barn-dried hay was of good grade, palatability and vitamin A value.

308. Wylie, C.E., Schaller, J.A. Proc. Amer. Soc. Anim. Prod., 1939, 32, 60

HAY DRYING SYSTEMS FOR SMALL FARMS. Describes the barn drying system for completing the drying of hay begun in the field. The system consists of air ducts on the floor, through which air is driven electrically. The artificially dried hay was higher in vitamin A content than and superior in palatability and quality to field dried hay.

309. Wylie, C.E., Hinton, S.A. J. Dairy Sci., 1940, 23, 555 (Abstr.)
Schaller, J.A.

STUDIES WITH BARN AIR-CURED ALFALFA HAY. Continuing studies of curing hay in the barn and the feeding value of air-cured hay, investigations now reported were concerned with automatic controls for curing equipment and the curing of hay to depths greater than 10 feet. The most promising method of automatic control embodies the use of a humidistat, placed outside the barn, and time switch. Alfalfa hay was cured, without heating or moulding, to a depth of 10 feet by using floor ducts. Hay was also cured satisfactorily to a depth of 14 feet by using flexible ducts placed on top of the first 10 feet of hay. Power requirements are stated. Gives results of tests with helpers, to compare the feeding value of barn air-cured and field-cured hays. Protein content of barn-cured hay was higher than that of field-cured hay. Studies have shown that good quality hay may be obtained by completing cure in the barn after partial curing in the field.

Field Drying

310. Brümmer, E. Tierernährung, 1940, 12, 77. Nutrit. Abstr. Rev., 1940, 10, 36.

UNTERSUCHUNGEN ÜBER DIE UNTERSCHIEDLICHSTE KONSERVIERUNGSMETHODE DES GRASHEU. Describes studies to examine the most efficient methods of preserving lucerne. With lucerne cut at the usual stage for hay-making, drying in the sun under favorable weather conditions and with careful handling was equal, in conservation of nutrients, to artificial drying at relatively low temperatures (70°C); for younger

lucerne, the latter process is probably better. Swedish racks, in which the crop can be placed immediately after cutting, have better results than tripods. For farm practice rack drying is recommended for the major part of the crop, with artificial drying as a supplementary process. Ensilage of young lucerne is an uncertain and difficult process; it was found that the losses of nutrients were high and the quality of silage only moderate.

311. Jones, T.N., Dudley, R.F. Agric.Engng.St.Joseph.Mich.29 159.1948
METHODS OF FIELD CURING HAY. A study of the rate of drying and nutrient properties of field dried crushed and uncrushed Johnson grass, Sudan grass and soybeans.

312. Jones, T.N., Leonard, G.A. Mississippi agric.Exp.Sta.Bull.
 Hamblin, I.E. No.353,1940. Exp.Sta.Rec.,1941,35,
 545.

METHODS OF FIELD CURING HAY. In addition to findings published previously (see Vol. 11, No. 1634), light, temperature, oxidative enzymes, copper, pH, relative humidity and the rate of drying were found to affect the manner in which carotene is lost from hay or hay plants.

313. Jones, T.N., Leonard, G.A. Mississippi agric.Exp.Sta.tech.Bull
 Hamblin, I.E. No. 27,1941. Exp.Sta.Rec.,1942,86,
 101.

METHODS OF FIELD CURING HAY. Reports that windrowing alfalfa hay aids natural transpiration, resulting in greater loss of moisture in a day. Photomicrographs showed a re-opening of stomata following windrowing 2 hours after cutting. Double windrowing 2 or 3 hours after cutting produced hay of better colour, a larger percentage of leaves and a lower moisture content at the end of the day. Leaves of alfalfa assisted in lowering the moisture content of the entire plant and also contained 80 to 90% of the proteins and vitamins in hay. Light, rise in temperature, oxidative enzymes, copper, fall in pH value, high relative humidity and decrease in rate of drying were found to increase the loss of carotene from hay or hay plants. Crushing large-stemmed hay (e.g. Johnson grass or soy-beans) shortened the curing time. Crushed hay could be stored with a carotene content higher than that of mowed hay and was as rich as mowed hay in proteins, sugars and dextrin, ether extract and ash.

314. Svoboda, F. Ann.Acad.tchécosl.Agric.,1939,14,9
 (Summary in German). Nutrit.Abstr.Rev.
 1939,9,276.

RESULTS OF VARIOUS METHODS OF DRYING LUCERNE (CRANIAL DIAL).
 Discusses the effect on losses of nutrient matter in alfalfa of drying on tripods, on wire fences and on the ground, using (1) green, freshly-cut and (2) wilted material. Successful drying was possible even in rainy weather when fences were used, but at the loss of much of its colour when dried in this way.

Beet Tops

315. H.M.S.O. 1949 Agriculture Overseas No.9 B.I.O.S.
Final Dept. No.1858.
BEET TOP CROP CONSERVATION IN GERMANY. Deals with the harvesting and drying of beet tops. Short treatments of the economic aspects, machinery for harvesting, cleaning and drying beet tops. Recommendations for similar conservation in U.K.
316. ——— Farmers Weekly 18 Feb.1949.
BEET TOPS AND VEGETABLE WASTE. No drying particulars except that the shredded material takes 2 hours to dry and has low B.Carotene content. Trials planned for dirt removal before drying.
317. Br.Sugar Beet Corp. Farmers Weekly p.29.25.2.49
BIG BUSINESS. British Sugar Beet Corporation is co-operating in a scheme for harvesting beet in return for the leafy tops. 1st Factory 1950 will require 2,250 acres of grass leys, 450 kale, 1,000 acres of sugar beet tops. Cubes for cattle, pellets for poultry and calves, meal for pigs.
318. Büttner-Werke, A. G. B.P.501,574 (March 1st,1939).
IMPROVEMENTS IN OR RELATING TO METHODS OF PNEUMATICALLY DRYING HEAT-SENSITIVE MATERIALS. In drying products such as beet leaves or lucerne by a stream of hot gases in vertical pipes, the gases enter at a temperature of about 500°C and leave at about 160°C. The rate of circulation of material is sufficient to cause the material separated for re-circulation to have a water content not exceeding 40% of the difference between initial and final water contents, so that the drying gas is rapidly cooled.
319. Ehinger, R. Tierernähr., 1939, 11, 389. Biol.Abstr., 1940, 14, 464. Chem.Abstr., 1940, 34, 826. Nutrit.Abstr.Rev., 1940, 9, 1078. J.Dairy Sci., Abstr.Sect., 1941, 24, A88.
UNTERSUCHUNGEN ÜBER DEN FUTTERWERT VON KÜNSTLICH GETROCKNETEM RÜBENKRAUT UND ÜBER DIE FUTTERWIRKUNG BEI VERFÜTTERUNG AN MILCHKÜHE UND AN ARBEITSPFERDE. Coefficients of digestibility of drum-dried sugar beet leaves were determined in studies with sheep and pigs. Increasing the drying temperature reduced the digestibility of crude protein by pigs but not by sheep. Feeding experiments with lactating cows and horses are described.
320. Hammer, W. Parey.Berlin 1936 R.K.T.L.72.
DIE TROCHNUNG VON RÜBENPLATTEN. (The drying of beet tops.)

321. Kirsch, W., Jantzon, H. Z.Tierernähr.Futtermittelk., 1939, 3, 129. Chem.Abstr., 1940, 34, 8098. Brit.chem. physiol.Abstr.B, 1940, p.760.

THE EFFECT OF ARTIFICIAL DRYING ON THE FEEDING VALUE OF FERMENTED BEET LEAVES(transl.title.) Except for a decrease in acetic acid content, the composition of ensiled beet leaves was not affected by drying. Digestibility of total organic matter and proteins was lowered somewhat by the drying process.

322. Lenkeit, W., Becker, M. Listy ukr., 1939, 57, 272. Chem.Abstr., 1939, 33, 7856.

THE NUTRITIONAL BALANCE IN SHEEP FED UPON ARTIFICIALLY DRIED FODDERS, PARTICULARLY UPON DRIED BEET TOPS(transl.title.) Estimations were made of available nitrogen utilized by sheep when about half the ration was replaced by beet tops dried in a Büttner drum drier or in a Büttner rotating drier. Repeated drying in either type of drier diminished the quantity of available nutritional nitrogen. Experiments were also made in vitro to determine the percentage of available raw proteins oxidized by drying.

323. Schmidt, J., Kliesch, J. Forschungsdienst, 1941, 12, 592. Chem. Zbl., 1942, 1, 3050. Chem.Abstr., 1943, 37, 3849.

UNTERSUCHUNGEN ÜBER DIE TROCKNENKOSTEN UND NÄHRSTOFFVERLUSTE VERSCHIEDENER GRÜNFUTTERARTEN UND ZUCKERROBENBLÄTTER BEI KÜNSTLICHER TROCKNUNG. Reports investigations of the cost of drying and loss of nutrients in different green feeds and sugar-beet leaves during artificial drying. Artificially dried green fodder (of which analyses are tabulated), particularly that prepared from young crops, has a high protein content. Digestibility was not affected by drying at temperatures of 4500 to 5000c. Loss of nutrients was the same in the case of beet leaves, which had lain for some time in the field, as for the other green fodders.

Beet Root

324. Anon. Demag.News, 63, 1-6, Feb. 1932.
GIANT DEMAG. DRUM DRYER FOR BEET SHREDS. DRIES 60 TONS PER 24 HRS. Installed at Buehl.

325. Chapman, F. M. et al B.I.O.S. Report No. 312 p.3.
BÜTTNER WERKE. It is thought that Automatic Control of beet pulp dryers was not likely to be achieved. The necessity of limiting the inlet air temperature to 500/1000c involves reducing the O₂ to 3.5-4% and the time in a large drier is as much as 30 minutes. In pulp drying, one must necessarily compromise between financial efficiency and quality of product.

326. Claassen, H. Zbl.Zuckerindustr., 1939, 47, 801. Chem. Abstr., 1940, 34, 826. Brit.chem.physiol. Abstr. B, 1940, p. 162.
- THE DRYING OF SUGAR BEETS, LEAVES AND TOPS AS WELL AS ALBUMINOUS GREEN FODDER (transl. title). Gives the crude protein contents after drum-drying of sugar beet chips, agricultural waste, alfalfa, red clover, vetch mixture and pure vetch. High digestibility is claimed for sugar beet fodder.
327. Dérivé Bull. Assoc. Chim. 1944 61 88-93
APPLICATION OF INFRA-RED TO BEET PULP. See under "Infra Red".
328. Ronoff, A. Food Research 1948 13 44-58-65 B III.
 185 July 1948. Chem. Abstr. 42. 18. 6953.
 20/9/1948
- THERMAL DEGRADATION OF DEHYDRATED BEET. Chromatography of red beet pigments.
329. Schiebe, K. Centr. Zucker Ind. 51 19-20 1943 B III
 p. 176 July 1948.
- Data for Coal consumption in Beet Processing. Data for factories in Bohemia and Moravia.
330. Scott Garrett, C. J.S.C.I. 46 1014-17 1927
DESICCATION PROCESS (De Vecchis) of Beet Sugar Manufacture. Whereas desiccation at 500-600°C had not been exceeded for fear of altering the sugar. De Vecchis found that slices dried at 900°C - 1000°C gave complete coagulation of albuminoids, and cosettes of 3% water, crisp and brittle, which could be extracted efficiently.
331. Wiemer, P. Arch. Warmewirts. 1938. 19. 193-4
CONTROL OF FIRING IN DIRECT FIRED SUGAR BEET DRYERS. (An illustrated report is given of tests conducted with two directly-fired beet dryers burning brown coal to investigate the effect of the air supply on drying and combustion. Optima working conditions are deduced from the results.)

Crushing

332. Bechdel, S.I., Clyde, A.W. Pennsylvania agric. Exp. Sta. Bull.
 Cromer, C.G., Williams, P.S. No. 396, 1940. Exp. Sta. Rec., 1940, 83
831.
- DEHYDRATED AND SUN-CURED HAY. The use of rotary drums and conveyor machines for artificial drying of hay was examined. To accelerate field drying, experimental crushers, in which stems are cracked by passing freshly cut hay between rolls, were tried. Details of operation are given. Results are reported of feeding experiments with dairy cattle, which showed the superiority of artificially dehydrated hays over field-cured or silage products.

333. Carr, R. G.

B.P. 516,101 (December 21st, 1939).
Divided out of B.P. 516,069 (see Vol. 12,
No. 400)

IMPROVEMENTS RELATING TO THE TREATMENT OF GRASS PRIOR TO AND DURING DRYING. Claims means for cutting and removing moisture from grass by a severing "squeezing" action, without rubbing action upon the tissues or surface cells of the grass, which comprise a pair of rolls of double helical or herringbone tooth form, driven to rotate at a high speed. The grass is cut into suitable lengths of approximately equal weight.

334. Lenkeit, W., Becker, M.

Zeit. Tierernähr. Futtermittelk., 1940,
4, 20. J. Dairy, Sci. Abstr. Sect., 1941, 24,
A244. Biol. Abstr., 1942, 16, 125

UNTERSUCHUNGEN UEBER DIE VERÄNDERUNG DER NÄHRSTOFFE DURCH KUNSTLICHE TROCKNUNG. Studies reported were concerned with food drying technique and changes in nutritive value. It was found that 60 to 90% of the carotene in beet leaves and red clover could be retained by shredding and pressing. In normal hay drying procedures, only 30% of the carotene content is retained.

335. Reed, R. H.

Agric. Eng. 13 69-70 March (1932)

RESULTS OF 1931 ARTIFICIAL DRYING STUDY AT UNIV. OF ILLINOIS ON CRUSHING THE ALFALFA AND SOYBEAN BY INCREASING DRYING RATE AROUND 75%.

336. White, J. W., Kalbfleisch, W.

Scientific Agric. 30 (3)

Exp. Farms Service Ottawa

March 1950 pp. 119-124

ROLLER CRUSHER FOR DRYING HAY. Timothy, alfalfa and clover mixtures were tested after crushing and alternate stacks of full grown crops in the roller crusher, 5 ft. rollers, in good hay drying weather. Purpose was to crush or bruise the stems. The crushed fodder dried below 25% moisture on the 1st day and could be stored. Uncrushed crop dried to 45% on first day and required a day longer than uncrushed, before storage. Considered beneficial for early cut hay but not for later and shorter crops which could not be fed through the roller with success. No significant difference in feeding value between the hays.

Vacuum Drying

337. Brier, J. H.

Mod. Refrig., 1940, 43, 104

GRASS DRYING FOR LIVE-STOCK: LOW TEMPERATURE TREATMENT. Gives an illustrated description of a low temperature vacuum drying apparatus. Grass is dried in a cylindrical vacuum chamber by heating to a temperature of 100°F (37.78°C) by means of a coil carrying steam or hot water from a boiler of the central heating type. Greater efficiency in drying and improved retention of natural qualities of the grass are claimed.

Fire Risk

338. ---- (Gas World, 1944, 120, Indust. Gas 80)
GRASS DRYING BY GAS-PIPED AIR-HEATERS. A brief diagrammatic description of a successful method of grass-drying whereby risks of fire and contamination from flying incandescent particles have been eliminated.
339. Wallace, J. Fire Res. Organisation F.S. Note 108/1950
FIRE CONNECTED WITH THE PROCESS OF DRYING GRASS, WHICH WERE ATTENDED BY FIRE BRIGADES IN G.B. DURING 1949. Analysis of 81 incidents.

High Frequency Application

340. Aldersley, Eng. Co. Ltd. Ind. Heating Engr. 11 (48) 150
Electr. Musical Industries Ltd. July 1949
HIGH FREQUENCY GRASS DRYING PLANT. Pilot model shown at B. I. E. Birmingham 8/1949 E.M.I. Model P.H. 75. The grass (or other herbage) is rapidly heated and the excess water pressed out. The pressed material is then extruded as a continuous ribbon of uniform thickness and density, and conveyed between belts to the oven unit, where it becomes heated between H.F. electrodes, losing moisture rapidly, then on to the delivery unit. Full nutritive value maintained, illustr.

Infra-Red Application

341. Moses, B. D. (Farm Electrification, May-June 1947, 1, 24-29)
INFRA-RED DRYING. A short note on some applications of infra-red drying in agriculture.
342. Zimmerman, G. Mitteilung aus dem Gebiete der Lebensmittel-untersuchung und Hygiene. 37, 35-57 1946 Eidg. Gesundheitsamt in Berne
Separat-Abdruck
THE APPLICATION OF INFRA-RED TO THE DRYING OF FODDER. Description of Infra-red radiation and absorption especially by water. Applications and drying of grass. Results. Heating effects. Data. Use of Infra-red increases water evaporation and does not impair protein content. 30 References

Storage

343. Goodall, C. B.P.502,715(March 23rd,1939).Addition to B.P.482,312
IMPROVEMENTS RELATING TO THE PRESERVING OF GRASS. Cut grass is heated in a bath of liquid, or in presence of its own moisture, to a temperature of about 180° to 212°F(82.22° to 100°C) and immediately afterwards stored in the wet condition in an air-tight container, such as a silo covered with clay. When required for use, the grass is removed from the container and dried or its surplus moisture may be removed by squeezing between rollers.
344. Slade, R. E. Green Crop Driers Research Assn. Handbook p.72.1949
Loft hay - 6-8lb/c.ft. baled hay - 14-20c.ft. chopped and trodden down - 12-14lb/c.ft.meal in bags - 18-25lb/c.ft. Dried grass will weigh 25lb/c.ft. when protein content is high, and 18lb/c.ft. when protein content is low.
345. Silker, R.E., Schronk, W.G. Ind.Eng.Chem.39, 1100 and 1103.1947
King, H.H.
STORAGE OF COMMERCIAL DEHYDRATED ALFALFA MEAL.
346. Wright, N. C. J.agric.Sci.,1941,31,194
THE STORAGE OF ARTIFICIALLY DRIED GRASS. Investigations were made of the effects of humidity and moisture on the keeping quality of artificially dried grass. The relation between moisture content of the dried grass and the relative humidity of the surrounding atmosphere was given by a smooth curve. At humidities of 80 to 90% the equilibrium moisture content was between 18 and 20%. The rate of moulding during storage was directly related to the relative humidity and therefore to the moisture content of the dried grass. For reasonably safe storage a relative humidity of 87% should not be exceeded, corresponding to a moisture content of about 13%. The importance of extending storage trials over long periods is stressed; in one instance mould growth did not occur until after 300 days. Attempts to detect mould growth at an early stage by plating were unsuccessful. The earliest and most reliable indications of mould growth were (1) the appearance of visible mycelium under a low-power objective and (2) a musty smell.

Nutritional Aspects

347. Bailey, G.F., Atkins, M.E. Ind.Eng.Chem.41, (9) 2033-36
Bickoff, E.M. Sept.1949
CAROTENE RETENTION IN ALFALFA MEAL. Effect of moisture content, sealed, tightly packed containers and initial loss. At 8% moisture content and with access of air only 70% and 25% carotene are

retained at 210C and 400C respectively, after 90 days. 8% moisture is suggested with sealed storage, similar to meals.

348. Becker, M.

J. Landw., 1939, 86, 249. Chem. Abstr., 1939, 33, 7413. Nutrit., 1940, 11, 369. Nutrit. Abstr. Rev., 1940, 9, 875

VERGLEICHENDE ERNÄHRUNG IM EINFLUSS VON KUNSTLICH GETROCKNETEN GRÜNFUTTER. MIT VERSUCHEN ÜBER DIE BEI DER VORBEREITUNG DES ROSENBLATTES TRETTENDEN VERLUSTE. Discusses the practice of artificial drying with drum-kiln and rotary driers of crops cut green and immature, e.g. beet tops, alfalfa, wheat, clover, other legumes and potato tops, and summarizes results of feeding experiments. Gives results of an experiment in which protein, nitrogen fractions, water, sand, ash, calcium and phosphorus contents of beet leaves, before and after washing, pressing and chopping, and of the expressed liquid were determined. It is pointed out that vitamins A and B, largely lost in natural drying, are mostly conserved by artificial drying. Comparisons are made of the value of the product prepared by several methods, and the generally improved feeding value, as compared with that of naturally dried feeding-stuffs, is emphasized.

349. Becker, M. Schleinitz, M. von.
Lagneau, E.

Zuchtungskunde, 1939, 14, 81. Chem. Abstr., 1939, 33, 4338. Nutrit. Abstr. Rev., 1939, 9, 221

VERSUCHE ÜBER KUNSTLICH GETROCKNETES GRÜNFUTTER. Digestibility trials with sheep and goats were carried out on sun-dried lucerne hay, lucerne chopped and dried in a drum drier, lucerne meal prepared in a rotary drier and field beans cut green and dried in a drum drier. Figures are given for the percentages of digestible constituents, ballast and starch value in the various materials examined.

350. Ewin, F.G., Grosfields and Palthrap

Milling, 8 Apr. 1939.
pp. 318-320, 334

CRITICISM OF THE STANDARD OF DRIED GRASS IN U.K. With 12% protein, Grosfields have had to reject 70% of all samples offered to them. The price of dried grass is very high, and, for poor qualities, far too high.

351. Bosch, S., Deijls, W. B.

Maandbl. Landbouw 4, 511, 1947
B111 317 Oct. 1948

CAROTENE IN DRIED GRASS AND SEEDS. Discussion of losses of protein and carotene in grass, clover, lucerne. These are supplemented by dried reed meal.

Bosch, S., Deijls, W. B.

Centr.Inst.Agric.Res.Wageningen.
Holland 43-49 1948

THE CAROTENE CONTENT OF DRIED GRASS. Herbage Abstracts, 20, (2)
1950 May.

353. Bridston, M.

Refrig.Engng.1941,41,114

THE GRASS MEANS MORE VITAMINS. Describes the preparation of "Cerophyl" (for human consumption) and "Cero-gras" (for animals) from cereal grasses. The grass is cut at the optimum stage of growth, dried immediately and pulverised into a "flour" containing 5% moisture, "Cerophyl" is claimed to be 10 to 80 times as rich in vitamins as fresh fruits and vegetables. It must be stored at a controlled temperature of 0° to 80°F (-17.78° to 13.33°C) to preserve the vitamins. The powders can be used in vitamin drinks, in poultry mash, etc.

354. Brouwer, E., Dijkstra, N. D.

Versl.Ver.Proefzuiv.Hoorn.1938,
p.177 (Summary in German p.140).
Chem.Abstr.1940,34,2092

VERTELBAARHEID EN VORDERWAARDEN VAN KUNSTMAATIG OEDROOGD GRAS. 1941s with the digestibility and food value of artificially dried grass. Determinations were made of digestible crude protein, digestible albumin and starch value in dried grass and it was found that results differed little from those obtained for fresh grass. Based on the quality of the dry matter, nutritive value of dried grass was higher than that of the best quality hay, but lower than that of other feeds.

355. Brouwer, E., Dijkstra, N.D.

Versl.Ver.Proefzuiv.Hoorn.1941,
p.83. Versl.Rijkslandb Proefst.,
Hoorn, 1041, No.47 (17)C, p.1275.
Chem.Zbl., 1942, 11, 1074. Chem.
Abstr., 1943, 37, 5155

THE CAROTENE CONTENT OF HAY AND STRAW. (Annal. 11122) It was found that the longer the period of field drying or bacterial action in hay or straw heaps, the greater were the losses of carotene. North Holland and Friesian hays were often deficient in carotene, owing to their method of preparation, and they must be supplemented by foods supplying carotene. The better the green colour of hay preserved, the higher was the carotene content.

356. Brown, W.O. N.Ireland Min.of
Agr. Laboratories

C. and I.1950 p.406.27 May 1950
Lecture. April 20 1950

DRINK WATER AS A RIBOFLAVIN SUPPLEMENT TO ANIMAL FEEDING. RIBOFLAVIN deficiency is not likely to be immediate in ruminants, but with chickens the body temp. is 107°F. is too high for bacterial synthesis of riboflavin. 2.5 u.g./gr. of feeding stuff is necessary to prevent curled toe paralysis. Cattle milk.

liver, dried yeast, had all been used. In dried grass, riboflavin ranged from 1.0 to 34.4 $\mu\text{g.}/\text{gr.}$ and was correlated with protein content. 10% of good quality grass meal containing 16 $\mu\text{g.}/\text{gr.}$ riboflavin met the requirements. 25 is too little, 185 is too much, the latter having an adverse effect.

357. Deijls, W. B. Cent.Inst.Agric.Res.Wageningen.Holland
1948.101-2

CHEMICAL LABORATORY REPORT. Includes the expression of juices from grass and their analysis. Herbage Abstract, 10 (5) May 1950.

358. Dixey, R. N. Farm Econ., 1939.3, 19.Nutrit.Abstr.Rev.,
1939, 9, 283

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84, 656

THE NUTRITIONAL VALUE OF THE ARTIFICIAL DRYING OF HOME-GROWN FORNERS (Transl. title). Studies were made of changes in composition, digestibility and nutritive value of forage crops at successive stages of growth. A series of equations was developed to determine the "concentrates equivalents" of 100 feed units of products made from different types of green forage by different methods of preservation. The Fehrmann and the Edholm systems seemed to give the best results. Artificially dried products are easier to distribute and transport. Losses due to preservation were less in products dried artificially than in silage made by any method.

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EFFECT OF YOUNG GRASS IN THE DIET ON THE ONSET OF SEXUAL MATURITY IN MICE. The mice respond to young grass (dried or fresh) as if they were obtaining a supply of oestrogenic materials from the grass. Climatic conditions and effect on the reproduction of farm animals.

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Davies, R. P.
THE EFFECT OF PARTIAL FIELD WILTING AND ARTIFICIAL WILTING ON THE
CHEMICAL COMPOSITION OF GRASS. An investigation has been reported
previously (see Vol. 10, No. 144) and has been continued. It was
confirmed that wilting in the field under favourable climatic
conditions can effect appreciable reductions in the cost of drying.
Wilting in the field or under cover appeared to have little effect
on percentage of protein present in the dry matter. Larger
amounts of carotene were lost during wilting in the field than
under cover or in jute scrim bags, and the most serious loss of
carotene occurred when the herbage was exposed to rain or sunshine.
Of the mineral constituents determined, potash appeared to be the
most liable to loss when the herbage wilts under unfavourable
conditions.
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THE VALUATION OF TRIFOLIUM GRASS. Concerning carotene and protein
content of fodder crops on storage.
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THE COMPARATIVE FEEDING VALUES OF GRASS WHEN FED GREEN, AS HAY AND
AS SILAGE. A comparison was made of composition and feeding
values of a crop of mixed grasses (1) when fresh, (2) made into hay
and stored for 4 months and (3) made into silage and kept in the
pit for 5 months. The conservation of green grass, either as hay
or silage, results in loss of nutrients and dry matter. The
feeding value of silage was at least as high as that of hay.
365. Halverson, A.W., Hart, E.B. J. Dairy Sci. 31 1008-15 (1948). Chem.
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THE INFLUENCE OF WATER LEVELS AND TEMPERATURE OF STORAGE ON
CAROTENE PRESERVATION IN DEHYDRATED ALFALFA, TREMUL GRASS, AND
MIXED FEEDS.
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DEHYDRATION OF SWEET POTATOES FOR LIVE-STOCK FEED. Describes a
method for drying potatoes, in which the ground material is treated
with sulphur dioxide before drying to prevent oxidation of pro-
vitamin A.
367. Kirsch, W. Tierernähr., 1939, 11, 273. Biol. Abstr.,
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Sci., Abstr. 1941, 24, A89
LEAF FURTHERFEED ANALYSIS, OR TROCKNETER ANSCHLIESSEN. In experi-
ments with sheep, determinations were made of amount of digestible
crude and pure proteins in yellow sweet lupin dried in a rotary drier.
The digestibility of the protein was reduced by artificial drying.

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CAROTENE IN HAY DETERMINED BY CARE IN CURING PROCESS. Reports a study of distribution of carotene in different parts of alfalfa, soy-bean, sweet clover and Johnson grass plants. Curing these plants in the shade for 24 to 30 hours resulted in a loss of carotene; drying in the sun for the same period resulted in still greater losses. Similar losses occurred in air-dried and sun-dried hays during field curing.
369. McKennon, W.C., Western States, Chemurgic Digest 8 (6) 29-30 June 1949
INDICATING GRASS FOR ANIMAL FEEDING. The preservation of protein and carotene. Grass as a source of carotene. Comparisons with hay. Production costs. A dehydrater should produce 1000-1200lbs. per hour. More mature grass 1200-1800lbs. and alfalfa 2000lbs. per hour or more.
370. Marston, H.R. J. Coun. Sci. Industr. Res. Aust., 1943, 18, 113
 Quinlan-Watson, F., Dewey, D.W.
THE DEHYDRATION OF LUCERNE (MEDICAGO SATIVA) AND ITS POTENTIALITY AS A CONCENTRATED SOURCE OF ASCORBIC ACID AND OF CAROTENE FOR HUMAN CONSUMPTION. Deals with investigations of (1) the ascorbic acid and -carotene content of lucerne and other species of fodder plants, (2) the effect of wilting on ascorbic acid content of cut lucerne, (3) factors involved in the destruction of ascorbic acid during dehydration of lucerne leaves, (4) means of preserving ascorbic acid during dehydration, (5) criteria which determine the design of machinery for dehydration of these materials, (6) properties of dehydrated lucerne leaf-meal and its use as a concentrated source of vitamin C for human consumption, and (7) the effect of storage on ascorbic acid and -carotene content of lucerne leaf-meal.
371. Mitchell, Schrank, Arch. Biochem. 18, 343-8 1948 B111 319 October 1948
EFFECT OF HIGH MOISTURE STORAGE ON PRESERVATION OF CAROTENE IN DEHYDRATED LUCERNE MEAL. High moisture content loses less carotene than low moisture content on account of acids developed and loss of oxygen during fermentation at high moisture content. The requisite moisture content is greater than 11.2%.

273. Moon, F. E.

Emp.J.exp.Agric., 1939, 7, 225. Chem. Abstr.,
1939, 33, 8849. Biol. Abstr., 1940, 14, 1486.
Nutrit. Abstr. Rev., 1940, 9, 574, Exp. Sta.
Rec., 1941, 84, 89

THE COMPOSITION OF GRASS AT VARIOUS STAGES OF MATURITY, AND THE CHANGES OCCURRING DURING HAY-MAKING, WITH PARTICULAR REFERENCE TO CAROTENE CONTENT. Reports a study of carotene content of the constituents in a mixed meadow herbage at 2-week intervals from April to July. Loss of carotene in mown grass occurred during 4 days in the swath under unfavourable weather conditions, but little additional loss occurred during the subsequent 6 days under more favourable curing conditions.

274. Nitzsche, M.

Dtsch. Zuckerindustr., 1939, 64, 539. Brit.
chem. physiol. Abstr. B, III, 1941, p. 72

DIGESTIBLE PROTEIN AND ITS BEHAVIOUR DURING ARTIFICIAL DRYING OF LUCERNE (transl. title). With correct conditions of harvesting, short withering and storage and favourable drying conditions for lucerne, a high-quality dry product could be obtained with little loss. Different drying methods and plant are discussed and the importance of chemical control of drying is emphasized.

275. Nitzsche, M.

Dtsch. Zuckerindustr., 1940, 65, 59. Chem.
Abstr., 1940, 34, 2484

VITAMIN A AND ITS SOURCE, CAROTENE, AS A VITALLY IMPORTANT FACTOR IN ARTIFICIALLY DRIED FEEDS (transl. title). Loss of carotene in artificially dried green fodders amounted to 10 to 30%. These dried materials were valuable as a vitamin food, even after long periods of storage. Carotene losses were much greater in foods prepared by other processes.

276. Perkins, A. E.

Bimon. Bull. Ohio agric. Exp. Sta. No. 208,
1941, p. 6. Exp. Sta. Rec., 1941, 84, 797. Chem.
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DRY MATTER CONTENT OF CROPS IN RELATION TO HAY- AND SILAGE-MAKING. Deals with methods of producing and testing crops that may be used and stored as silage and hay. Crops cut before the heading or bloom stage usually have a dry matter content ranging from 15 to 18%. If crops containing less than 10% dry matter are ensiled by themselves, without drying or mixing with drier material, loss of juice is likely to occur and quality of the resulting silage is poor. Spontaneous combustion is most likely to occur when hay is stored containing 55 to 75% dry matter.

376. Pollock, E. O. U.S.A. Dep. Agric. Misc. Publ.
Hosterman, W. H. No. 363, 1939. Exp. Sta. Rec., 1940, 82 805
HAY QUALITY: RELATION TO PRODUCTION AND FEED VALUE. Based on a compilation of experimental data, quality in hay is discussed with reference to stage of maturity, value of leaves in hay, green colour, foreign material, vitamins, condition, size and pliability of stems and aroma. Other items dealt with include cuttings per year, curing and storing methods, chopping of hay, and the relationship between grade and price of alfalfa.
377. Ramp, R. M. Agric. Engng. St. Joseph, Mich., 1940, 21, 472
THE DRYING OF GRASS. Describes machine-drying of immature grasses (not to be confused with the artificial drying of hay). It is claimed that the process gives a product which retains most of its original green colour, and that the frequent clipping of the green grass increases yields of protein by 40 to 50% over that recovered by the usual hay-making procedure. More than 3 times as much carotene was preserved through artificial dehydration as by field curing. Loss of carotene during storage in bales was most rapid during the first few months, particularly in hot weather, but the final product still contained 2 to 5 times as much carotene as hay at time of storage.
378. Rozov, N. K. Sovetsk. Zootekh., 1939, No. 7, p. 71. Khim. Ref. Zh., 1939, 2 (No. 12), 35. Chem. Abstr., 1940, 34, 8098
CHANGES IN THE COMPOSITION OF PROTEIN SUBSTANCES AND CARBOHYDRATES DURING THE DRYING OF HAY (transl. title). Gives losses in sugars, starch, proteins and fats during the drying of vetch, clover and meadow grass for 36 to 126 hours and after drying in the sun.
379. Simonsen, Karl U. British Chemical Digest, 3 (2) 54-55
Nov. 1948 from Home Farmer 15 (10)
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ARTIFICIALLY DRIED GRASS. Objects of Drying:- Feeding Value - Varying Standards. Protein and carotene standards (various months of the year). Guarantees - Need for correct appreciation.
380. Slade, R. E. J. Min. Agric. (Lecture) 54 443-50 BILL
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CONSERVATION OF FODDER CROPS FOR WINTER FEEDING. Yields of nutrients. Losses of carotene. Conservation of carotene by silage making. (See also J. Farmers Club 8 104-126. 1947)

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Moscow, 1938,3,132 (Summary in English).
Nutrit.Abstr.Rev., 1939,9,57
ARTIFICIAL DRYING OF VARIOUS KINDS OF GRASSES (trans, title).
Samples of nettles and of mixtures of clover with timothy grass
and of vetch with oats (all gathered and dried under similar condi-
tions) were found to contain 28.9, 15.4 and 17.4% protein and
0.026, 0.029 and 0.028% -carotene, respectively. By animal assay
the 3 dried meals were shown to be good sources of vitamin A.
Dried nettles are recommended for poultry feed because of their
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TROCKNUNG. The preservation of protein in pasture crops by
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THE CAROTENE (PROVITAMIN A) CONTENT OF OKLAHOMA FEEDS. Deals with
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immediately after drying and after varying periods of storage.
Properly cured hay contained about $\frac{1}{2}$ as much carotene as green
forage and only $\frac{1}{3}$ of that of the green plant after 6 months'
storage. Carotene in silage was stable over long storage periods,
averaging at least $\frac{1}{2}$ of the initial value after 6 months.
Intensity of green colour proved to be a useful qualitative index
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THE NUTRITIVE VALUE OF SILAGE AND DRIED GRASS.
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OF THE N-CONTAINING SUBSTANCES IN FOOD AND FOOD STUFFS. DIGESTI-
BILITY, BIOLOGICAL VALUE, AND RETENTION OF NITROGEN VALUE IN
LUCERNE. A rise of 10° between 130 and 140°F has same effect as
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 water contributed by respiration, varies with F.H. and inversely
 to surface area, and the optimum temperature for high respira-
 tion. In all, some 25% of the heat is from respiration. Curves
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 tion and type of engine.

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HOP DRYING. The general process of drying hops from 80 to 6% moisture content is briefly described but only as regards the employment of the already heated air. Various methods are employed for heating the air, open anthracite fires, open flame oil burners, stove heaters and steam radiators. The present system is not at all thermally efficient. Recirculation of the air has been found ineffective. The author advocates the use of a continuously acting dryer instead of the batch drying kiln at present in general use. Points of importance in the designing of a dryer are summarised. Some data are given including the time lag in drying out the strig after the leaf is dry.

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HOP DRYING. Process and fuel data are given.

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EFFECT OF DRYING METHODS ON PYRETHRIN IN PYRETHRUM FLOWERS II.
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TEA

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TOBACCO

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RECOMMENDATIONS FOR CURING BURLEY TOBACCO.
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FERMENTATION OF CIGAR TYPE TOBACCO. The article aims to explain
the primary reaction which takes place when such leaf is piled in
bunks of 2,000 to 40,000 lb. at 30% to 40% moisture. The procedure
has remained unchanged for many years. Prepared by adding enough
water to the dry bales to prevent breakage when hands are removed,
Filler tobacco includes all except binder and wrapped leaf.
Wrapper bunks may contain 4,000 lb. at 28-32% water and allowed
to ferment until reaching 50°C. Binders and fillers - bunks are
large 20,000-40,000 lbs., -32-40% M., 55-70°C. High moisture and
temperatures are permissible when dark leaf is not objectionable.
Sour wine or vinegar may be added to develop attractive aroma.
Invariably, heat, CO₂ and NH₃ are generated. A loss of dry
matter takes place, including nicotine and other nicotine com-
pounds, fibre and water soluble substances. For cigar tobacco (at
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tobacco will not ferment, therefore not chemical; may be for
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442. Barker, A. Inst. of Fuel. "Drying Study"
Thomas, T. March 1951
VEGETABLE DRYING. A survey of the classes of equipment available for processing vegetables. An account is given of the methods of preparing vegetables and of the need for careful selection. Examples of operating data are given.
443. Burgess, A. H. Inst. of Fuel. "Drying Study"
March 1951
HOP DRYING. Hop cones are reduced from 80% to 9% moisture, subsequently rising to 10% during storage. The importance of "Market value". The hop kiln is a batch dryer, with through draught, either forced or natural. The effects of temperature, air-speed, atmospheric humidity and depth of loading are described. The present type of kiln has a low thermal efficiency. An expression is given for the two periods of drying, "minimum time" and "extra time".

444. Cashmore, W. H.

Inst. of Fuel "Drying Study"

March 1951

DRYING IN AGRICULTURE. A survey of the development of drying of farm products in U.K., dealing with the operating requirements imposed by the material characteristics and the final quality. Critical temperatures, design and performance of dryers and capital and running costs are discussed. Data on these aspects are presented.

445. Macdonald, J. C.

Inst. of Fuel "Drying Study"

Phipps, O. H.

March 1951

THE DRYING OF SUGAR BEET PULP. The pressed cosettes containing 82% moisture are dried as pulp in rotary dryers, direct fired, with parallel flow, and with shelf or cruciform arrangements. The efficiency of the process is discussed, and the main trends suggested are to automatic control and reduction of initial water content by pressing.

446. Rosin, P. O.

Inst. of Fuel. "Drying Study"

March 1951

THE DRYING OF SUGAR BEET TOPS. The components are leaves, stalks, crowns and dirt, these having different structures and drying rates. The proportions, moisture protein and fibre contents of the first three are compared. The proportional effect of dirt is high and washing is expensive and causes loss of nutrient. The authors' investigations into screening and wind-sifting have resulted in 1950 in a content of sand and silica of less than 3% (30 mesh screen). Notes are added on the scope of beet top drying in this country. Curves of moisture relations and drying rates. References quoted B.I.C.O. Final Report 1950 and the Report of the British Sugar Crop. "Times" 26 Sept. 1950.

447. Woodforde, J.

Inst. of Fuel. "Drying Study"

March 1951

FARM DRYING OF GRAIN AND SEEDS. A review is given of a number of drying machines, and plants with the object of summarising the diversity of design and conservation process. The problems resulting from the wider use of combine harvesters are presented and some future problems are discussed well illustrated, with particular reference to bin or silo drying and times of drying.

448. ----- Min. of Agric. and Fish. 36-38
Chester Terrace, N.W. 1.
FARM MACHINERY LEAFLET NO. 4. 1951. GRAIN DRIERS. Practical details for guidance in the operation of continuous and tray type grain dryers. Requisite temperature limits are given.
449. ----- Br. Fl. and Allied Inds. R. A. Tech. Rep.
1B/T. S. June 1951
SOME NOTES ON THE DESIGN, TESTING, AND PERFORMANCE OF AN ALL-ELECTRIC 100-SACK GRAIN DRYER. Economies based on adjustment of the rate of air flow. Recommendations for design are made.
450. ----- Br. Flour Millers Res. Assn. Third Bulletin.
Apr. 1925
SOME EFFECTS OF MOISTURE ON WHEAT. A resumé of the literature, and a discussion of aspects of moisture relations and effects of moisture on the properties of wheat.
451. Bailey, P. H. and Nat. Inst. of Agric. Engg. Silsoe. 1950
Hamblin, H. J.
THE TESTING OF GRAIN DRYERS. A report on the problems encountered in the development of a N. I. A. E. testing technique and a discussion of the theory of grain dryer characteristics. Herbage Abstr. 21.2.494. May 1951.
452. Barlow, G. E. et. al. Virginia Agric. Exp. Stn. Bull. 439. 1950
PEANUT HARVESTING AND DRYING RESEARCH, 1947-8-9. A description and discussion of experimental work drying and bin drying processes. The minutes of the Peanut Harvesting and Drying Conference, Jan. 1950, are reported. See Herbage Abstracts, 21.2.751. May 1951.
453. Butt, J. L. and Agric. Engg. 32.1.27-32. Jan. 1951
Kummer, F. A.
ARTIFICIAL CURING OF PEANUTS. Expts. by Alabama Expt. Stn. A study of the effects of variables on the rates of drying.
454. Cook, D. Farm Electr. 4. 17-19. Sept./Oct. 1950
NEW TYPE HAY DRYER DESIGNED BY A MICHIGAN FARMER. Drying is done by a 2 1/2 H.P. 22 in. fan at the bottom of a 22 ft. high, 4 ft. square air shaft. Doors are placed at 1 ft. intervals which can be opened or closed to control air movement into the hay which is stacked around the shaft. B.E.A.
455. Davis, H. D. and Agric. Engg. St. Joseph. Mich. 32. 11-25. 32-34.
Baker, V. H. 1951.
1. THE FUNDAMENTALS OF DRYING Baled HAY.
2. THE RESISTANCE TO AIR FLOW OF LONG AND CHOPPED HAY.
Results of experimental work with a view to the design of hay dryers.
456. Dixey, R. N. and Agric. Econ. Res. Inst. Oxford. 1939
Butler, J. B.
GRASS DRYING ON THE FARM.

457. Dreosti, G. M. and Louw, J. D. Farming.Sth.Afr. 23(5) 1948
DRYING OF GRAIN IN BAGS. Operating data, costs, output and kilograms are presented. Fruit Res.Stn.Stellenbosch. Dep.of Agric. Fruit Res.Technical Series No.29.195.40pp. Part 1. Laboratory Expts. Part 2. Expts. on a semi-commercial scale. Part 3. Effect of heat on grain. Part 4. Estimated cost of dryer. A graphical presentation of the effects of many variables is given.
458. Ede, A. J. Food Inv.Board.Int.Rec.Mem.No.100.1941
NOTES ON THE RELATION BETWEEN HEAT TRANSFER AND WATER TRANSFER IN WHEAT GRAINS. It was found that the water content was a linear function of the R.H. in the range 0.25 to 0.70 at temps. between 0°C and 80°C. The grain was found to heat more rapidly at higher R.H. than at low.
459. Gane, R. J.Soc.Chem.Ind. 60.44.1941
THE WATER CONTENT OF WHEATS UNDER VARIOUS CONDITIONS OF TEMPERATURE AND HUMIDITY.
460. Gordon, E. D. and Hurst, W. M. U.S.Dept.Agric.Circ.No.443.1950
ARTIFICIAL DRYING OF FORAGE CROPS. A revised edition of the 1937 issue, and containing information on the testing of dryers and the feeding value of dried foragers. Herbage Abstr.21.2.425.May 1950.
461. Kramer, H. A. Rice J. (New Orleans) 53.10.11.19-21.June 1950
EFFECTS OF DRYING ON THE PROPERTIES OF ROUGH RICE. Description of laboratory experiments on the drying of rice and the effect on quality.
462. Reaves, P. M. Virginia Agric.Exp.Stn.Bull.431.1950
BARN CURED VERSUS FIELD CURED HAY. Chemical analysis, carotene retention after storage, and milk yields indicated the advantages of barn cured hay. See Herbage Abstr.21.2.407.May 51.
463. Sorenson, J. W. Agric.Engg. 29.397.1948
DRYING PEANUTS WITH HEATED AIR. Description of drying in racks in barn hay dryers. Precautions against overdrying of bottom layers. Recommended use of low temperature, high velocity air, and a moisture limit of 6 to 7% to avoid cracking. (With drying air at 140°F., the temperature of the nuts can be as high as 120°F. without detrimental effect on germination.
464. Sprenger, J. J. Landbouw-tijdschr. 63.243-254.1951
A GENERAL LAW FOR THE DRYING OF AGRICULTURAL CROPS. Transl.title. Theoretical data are given for the purpose of providing fundamental information on the drying of grain. English Summary. (Herbage Abstr.)

465. ~~Williamson, W. F.~~ and ~~Williamson, W. F.~~ ~~U.S. Nat. Agric. Eng. Report U.S. 7/1194. 1949.~~
Williamson, W. F.
CROP DRYER DEVELOPMENT.
466. Wratten, F. T. Rice Jnl. 53. 12. June 1950
THE APPLICATION OF DIELECTRIC HEATING TO CROP PROCESSING. Describes
the possibilities of the method but emphasizes the need for funda-
mental information on the movement of water in rice grains, etc.
467. Anglo-American Council Productivity Team Report pp. 55-58. Aug. 1951
on Productivity
THE HOP INDUSTRY, (of U.S.A. and Canada).

SECTION 4. FOOD

FOOD GENERAL

1. Various Authors Thorpes Dict. of Appl. Chem. 10, 196-213, 1950
PRESERVATION BY DRYING OF FOODSTUFFS. Methods for egg, fish, fruit, meat, milk, vegetables, sera. Processing conditions and nutritional aspects are described. The respective authors are:- Morris T. N., Reay G. A. and Cutting C. L., Furlong C. R., Eate-Smith E. C., Smith J. A. B. and Lea C. H., Tomkins R. G., Greaves R. I. N. Short Bibliographies to each section.
2. ----- U.S. Dept. Agric. Bibl. Bull., No. 6, 1945
DEHYDRATION OF FOODS. Bibliography 1938-1943.
3. ----- Sci. Libr. Bibl. Ser. No. 621, 1943-45
THE WATER VAPOUR PERMEABILITY OF WRAPPING MATERIALS WITH SPECIAL REFERENCE TO THE FOOD INDUSTRY. 21 Refs.
4. ----- U.K. Progress Reports D.S.I.R. and Min. of Food, 1943, 400 pages
DEHYDRATION. A compendium of 23 reports by various authors, on the experimental results of drying animal and vegetable foodstuffs. A very large amount of tabulated data is included on the physical properties and relationships of the materials. References under the separate materials.
5. ----- B.I.O.S. Misc. Report No. 19, Part 1, 1941.
A SURVEY OF GERMAN WARTIME FOOD PROCESSING, PACKAGING AND ALLOCATION. Section 3, pp. 70-102, - German Dehydrated Foods.
6. ----- B.I.O.S. Report No. 275
DRYERS FOR FOODSTUFFS, GERMANY.
7. Anon. Rep. Council of Sci. and Ind. Res. Aug. 1938-1939, 13, 70 Australia
FOOD PRESERVATION INVESTIGATIONS. 7 Physics. (i) General. (ii) Cooling of a Wet Body. (iii) Permeability to Water Vapour of Wrapping Materials. (iv) Evaporation of Water from Oranges. (v) Overseas Transport Investigations. (i) Deals with the duties of the Physics sub-section. (ii) Work has been continued on the cooling of a wet body, but graphical methods were used instead of arithmetical methods in some cases. (iii) A standard method for measuring permeability to water vapour of wrapping materials was modified and a number of treated papers and other materials were tested. (iv) Measurements of the rate of evaporation at various

relative humidities and at a temperature of 70°F. (21.11°C) were made with freshly-picked Washington Naval and Valencia oranges, and the effects on rate of evaporation of several different waxing treatments and also of washing in a borax solution were studied in oranges stored at 40° and 70°F. (4.44° and 21.11°C). (v) Experimental shipments of beef, eggs and fruit have been carried out in co-operation with the British Food Investigation Board. A further detailed survey was made of physical conditions in refrigerated cargo spaces of a modern vessel stowed with chilled beef, loss of bloom and weight being assessed in addition to physical measurements.

8. Anon. Food Packer, 1943, 24, 647. Canner, 1943, 97(No. 23), 22.

TEST HYDRAULIC PRESS FOR DEHYDRATED FOOD. Brief report of tests on production of compressed dehydrated vegetables, using a hydraulic compression unit, which can produce 8-10 bricks of carrot at the rate of 4 per minute.

9. Anon. Food Industr., 1942, 14(No.9), 72.
Canner, 1942, 95(No.12), 12

NEW PACKAGE FOR DEHYDRATED FOOD. A note reporting that the U.S. Army has developed a new "3-in-1" container for dried foods, which is moisture and insect-proof and withstands submersion in salt water. The container was designed primarily for shipping white potatoes, sweet potatoes, beets and yellow turnips, but shows promise for packaging other dehydrated products. The main feature of the container is the use made of laminated paper.

10. ——— Colonial Res.Repts.1946-7/P. 33 H.M. S.O.

TRINIDAD RESEARCH INTO VACUUM-OIL FOOD DRYING.

11. Anon. U.S. Dpt. Agric. Misc. Bull. No. 540,
July, 1944

FOOD MANUFACTURE. Gives a complete account of plant and methods for the benefit of manufacturers.

12. Edit. Discovery, 4(5), 137-143, May, 1943

THE DEHYDRATION OF FOODSTUFFS. Distinction between "Dried", "Sundried" "Evaporated", "Dehydrated". Water contents of foods before and after drying.

Fruit - Tunnel Dryers, (Apples in particular)

Vegetables - " "

Butter - Vacuum. Dried Fat

Meat - Slicing and Roller Drying

Soup - Drum Drying

Packing (General). Wrappers.

13. Edit. Discovery, 8(3), p.71, March, 1947
Egg protein more easily spoilt than, say, milk protein. Milk can be dried on rollers at 110°C. Even then, only 4/5 of milk powder goes back into solution. Egg should be spray dried in hot air not above 80°C. Egg protein stable at 70°C. Blood plasma is spray dried at 70°C. - 80°C but final product contained too much water for good storage.

14. --- Federal Standard Stock Catalog. U.S.A.
Specifications for Beef, Beans, Apples, Apricots, Currants, Milk, Peaches, Pears, Peas, Prunes, Raisins.

15. Anon. Fruit Prod.J., 1942, 21, 372
THE COMMERCIAL DEHYDRATION OF FOOD IN WAR-TIME. A review, with special reference to the commercial dehydration of vegetables, soups, apples and other fruits and citrus juice concentrates.

16. Various Authors Mass.Inst. of Technology, 1942-1945,
1,000 pp.
RESEARCH REPORTS OF THE QUARTERMASTER CONTRACT PROJECTS FOR 1942-5, 3 VOLS. Detailed accounts of investigation into food dehydration. Various foods are dealt with, but the chief emphasis is on the freeze drying of citrus juices.

17. Cttee. on Milk and Dairy Products Amer.J. Public Health 1947
37, 1113-1120, BIII, 183,
July, 1948
MILK, CHEESE, BUTTER. Riboflavin, Thiamin, Vitamin A and all aspects considered incl. evaporation, drying, storage.

18. Anon. Canning Age, 27, 188, 1943
See under "VACUUM DRYING".

19. Anon. Food Industr., 1942, 14(No.11); 54
ARMY STANDARDS FOR DEHYDRATED FOODS. Gives specifications for packaging dried vegetables and for preparation, blanching, dehydration, quality standards and re-hydration of white and sweet potatoes, rutabagas and beets.

20. Anon Food Industr., 1943, 15(No.1), 55
ARMY STANDARDS FOR DEHYDRATED FOODS. Tentative specifications for dehydrated foods for use by the army have been issued by the U.S. Quartermaster Corps. Lists the requirements for dehydrated carrots, cabbage and onions. Changes in specifications published previously are given also.

21. Anon. Food Industr., 1943, 15 (No. 2), 71
ARMY SPECIFICATIONS FOR DEHYDRATED FOODS. Tentative specifications for dehydrated foods for use by the army have been issued by the U.S. Quartermaster Corps. Specifications for soup mixtures, baked beans and tomato juice cocktail are presented.
22. Anon. Food Industr., 1943, 15 (No. 3), 52 and (No. 5), 58
ARMY SPECIFICATIONS FOR DEHYDRATED FOODS. Tentative specifications for dehydrated foods for use by the army have been issued by the U.S. Quartermaster Corps. Specifications for dried eggs and cream of Swiss cheese soup (composed of dehydrated Swiss cheese, dried (whole) milk, potato flour, oat flour, soya flour and flavouring ingredients (dehydrated vegetables or vegetable powder, vegetable protein derivatives, salt) are presented. New specifications for dried eggs, which supersede earlier ones, and for dried cheese are given. (See also Vol. 15, No. 549).
23. Anon. Food Industr., 1943, 15 (No. 6)
ARMY SPECIFICATIONS FOR DEHYDRATED FOODS. Tentative specifications for dehydrated foods for use by the army have been issued by the U.S. Quartermaster Corps. Specifications for dehydrated prune powder, dehydrated cranberries and dehydrated apple nuggets are presented.
24. Barry, T. H. Food, 19, 223, pp. 139-42, Apr. 1950
DEHYDRATION OF FOODSTUFFS. Development Part I. Traces development of process, qualities and equipment, from Boer War onwards with references and the sources of development. Boer War. Dried Vegetables of which the majority packed in waxed barrels, kept till the 1914-19 war. In 1914-19 War, U.S. Forces supplies of dried vegetables were not very satisfactory.
25. Barry, T. H. Food Apr. 1950, 19, 223, 139-142
DEHYDRATION OF FOODSTUFFS. PART I. DEVELOPMENT. References given:-
 - Ann. Amr. Acad., 11. 1919, (83), 14 { Prescott, S. C.
 - U.S. Dept. Agric. Bull., 1335, 1925 { Sweet, L. D.
 - J. Amer. Soc. Heat. Vent. Engr., 1927, 33, 381 { Nichols et al
 - Trans. Amer. Soc. Mech. Engrs., 1943, 65, 837 { Christie, A. W.
 - U.S. Dept. Agric. Misc. Bull. 540, July 1944. { Matsumoto, K.
 - Above are Fruit and Vegetables { Brown, A. H.
 - U.S. Dept. Agric. Circular 706. 1944. Meat, little studied until then. { Kirkpatrick, P. W.
 - Complete account of { Cruess, W. V.

- In G.B. little work until D.S.I.R. took it up in 1938.
 - Food Indr. 1945, 20, 271 and 277 Finner Special Drying Unit Number.
 - Handbook by Ministry of Food, 1944
 - Univ. Calif. Agric. Expt. Sta. Bull. 404, 1929
 - D.S.I.R. F.I. Spec. Rept. No. 53
- Christie, A. W.
Nichols, P. F.
Ede, A. J.
Hales, K. C.

Hop kiln for fruit and vegetables.

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 - Food Inds., 1942, 14, (10), 43 and (II), 47.
 - U.K. Progress Reports Sect. 10, pt. 3, M.O. F. 1943
 - J. Ind. Eng. Chem., 1921, 13, 432,
 - D.S.I.R. Rept. 53.
- Ridley, G. B.
Arsdel, Van
Carrier, W. H.
Ede and Hales.

Above are Mathematical and Scientific Investigations.

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 - Canad. Agric. Expt. Tech. Bull. 18, 1938. J. L. Ede, designed centre exhaust dryer.
 - J. Ind. Eng. Chem., 1921, 13, 432
 - Tr. Amer. Inst. Chem. Eng., 1942, 38, 91
 - U.S. Dept. Agric. Circular (Vac. Drying), 519, 1941
 - Ind. Eng. Chem., 1938, 30, 996
- Carrier, W. H.
Stacey, H. F.
Marshall, W. R.
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Erisman, J. L.

Link Belt dryer

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 - J. Dairy Res. 1945, 14, 122, 1946, 14, 387
 - Proc. Inst. Food Techn. 1945, 160
- Smith, A. W.
Lea, H.
Findlay, J. D.
Smith, J. A. D.
Moon, L. T.

Citrus juices

- Chem. and Ind., 1937, 56, 618
- Reavell, A.

Climbing film evaporator.

26. Bate-Smith, E. C., Morris, T. N. Cambridge University Press, 1951

LECTURES IN FOOD SCIENCE.

27. Berlin, P. Spirto-Vodochn. Prom., 1939, 16, (No. 2), 29.
Chem. Abstr., 1941, 35, 1927

FUNDAMENTAL PROBLEMS IN DRYING CEREAL-POTATO MALT PRODUCTS.

(Transl. title). Favourable results were obtained by neutralising acid with lime to prevent corrosion of trays and consequent contamination of malt products with iron. The added alkaline was beneficial to the malt. Centrifuging filtrates was an important aid to purification.

28. Birdseye, Clarence Food Technology, 1, (2), April, 47,
p.142-6
ENGINEERING ASPECTS OF DEHYDRATION. The Annularization Process.
The annularizer is a belt dryer, 40 ft. long with 5 belts in descending series. Each belt is in a tunnel, which is heated by a roof radiator, by a floor heating unit, and by hot air. Belts are of stainless steel mesh. Temperatures from 140°C-200°C. Feeders at frequent intervals over the belts. Winnowing action by air blast, to speed up lighter portions. 3000-3000 lbs. per hour capacity. Steam supply at 100-125 p.s.i., or combustion gases for heating air. Suitable for fruit and vegetables and similar materials. Made by Cleaver-Brooks Co. of Milwaukee.
29. Borden Co. B.P. 613,548, 9.5.46, B.I. 442, June, 1949
(DRYING OF POWDERED (FOOD) PRODUCTS. Warm material is fed to a vacuum tube 250 feet long x 2 inch. diam. enclosed in a hot water jacket. Agitation by vibration or small amounts of air. Moisture is reduced to less than 2%.
30. Brandner, J. D., Goepf, R. M. U.S.P. 2,420,517, 7.5.43
Atlas Powder Co.
DEHYDRATION OF FOOD BY HYPEROXYLIC LIQUORS. Sliced vegetables such as sliced and blanched carrots and beets are immersed successfully in increasing strengths of corn or similar syrup for periods up to 1 hour. The materials are drained and oven dried. Improved flavour results.
31. Br. Food Machinery Mnfrs. Assn. Illustrated Brochure of Mnfrs.
of Food
PROCESSING MACHINERY.
32. Chace, E. M. Proc. Inst. Food Tech. 1942, 3, 70.
Chem. Abstr., 1943, 37, 951
THE PRESENT STATUS OF FOOD DEHYDRATION IN THE UNITED STATES.
Summarizes briefly developments in vegetable drying in the United States under war conditions. Gives an account of the various operations (washing, cutting, blanching, drying and packing) in a drying plant for vegetables and deals with some of the problems involved. Discusses losses of vitamins during processing and storage of dehydrated vegetables and storage conditions necessary for maximum retention of vitamins, colour and palatability.
33. Conrad, R. M., Greene, J. W. Symp. on Food Technology, 1948
Am. Chem. Soc., 113d Meeting, Chicago,
See Chem. Eng. Prog. Vol. 44, 1948
Conrad and Greene, and stated that although vacuum drying is considered the best process, it was usually too costly.

34. Crosbie Walsh, T. Agric.:J.Minist.Agric.,1943,50,231
DEHYDRATED FOODS FOR MAN AND BEAST. Outlines developments in the past 3 years (1940-43) in the dehydration of foods and feeds, with special reference to the production of dried grass and the drying of grain and to the drying of vegetables for human food.
35. Deest, Van S. Heat.Pip. and Air Cond.J.Sect.Amer.Soc.
Heat.Vent.Engrs.,1943,15,440
THE SPRAY METHOD (LIQUID DRYING). Discusses the theory and practice of spray drying liquid foods such as eggs, milk, etc.
36. Dérivé, M. Elektrizitätsverwertung, Jan.-Feb.1948,
vol.22,171-176, 205-210
SOME APPLICATIONS OF INFRA-RED DRYING IN FOOD INDUSTRY. The advantages of drying vegetables and fruit are set out with the desiderata for efficient drying and the particular advantages of infra-red drying, i.e. quicker results. Preservation of vitamin C as well as of the structure of the product dried. Illustrations of domestic and industrial installations are given. The drying of flour and grain is also described. Part 2 describes the drying of milk and sugar, the accelerated ageing of wines, pasteurisation of milk and the roasting of coffee. The baking of biscuits and cakes is also touched upon. A treatment is given of the absorption characteristics of various fruits and vegetables, eggs, fish, etc. Diagrams and illustrations of the apparatus used, and tables of results of experiments are given, together with absorption characteristics. (in French).
37. Donelly, J. C. U.S.P.2,433,348.30.12,1947 BIII p.289,
9,1948
COMPRESSED FOODS. Cool to 0°-4°/C. and press at 200-4000 p.s.i.
38. Donovan, J. Food Techn.1,95-101,1947,BIII,288,
Sept.1948
ASPECTS OF FOOD PROCESSING EQUIPMENT DESIGN FROM VIEW POINT OF HEAT TRANSFER. Theoretical considerations. Accurate calcns. of heat transfer by radiation, conduction, and convection. Main points requiring attention in the design of plant are listed under 22 headings.
39. Ede, A. J. U.K.Progress Reports,Dehydration 1943,
D.S.I.R.and Min.of Food x(2),pp.1-15
RAW DATA ON DRYING CHARACTERISTICS OF DIFFERENT FOODSTUFFS. The variables in the drying processes are discussed and results of experimental work are tabulated. A list of Low Temperature Station (D.S.I.R.) records is given.

40. Egeler, C. E. Food Packer, 29, (5), 50, 1948
INFRA-RED ENERGY IN PROCESSING FOOD. General considerations and certain advantages in use of I.R. Design aspects are listed. Fruit, vegetables, fish and agricultural products have been dried.
41. Eidt, C. C. Food in Canada, 1942, 2(No.12), 17
THE MECHANICS OF DEHYDRATION. Deals with reasons for and methods of using heat and humidity in dehydrating vegetables, with reference to the functions of air, heat and humidity, critical temperatures and the necessity for a large surface exposure.
42. Faure, A. Bull.Soc.Ing.civ.Fr., 1941, p.151,
Chem.Zbl., 1942, 11, 1525. Bull.int.Inst.
Refrig., 1942, 23, 41
DEHYDRATION OF FOOD PRODUCTS (transl. title). Discusses artificial drum-drying, hot air vacuum-drying and spray-drying, with special reference to the drying of fruits and vegetables.
43. Flösdorf, E. W. B.P. 513,562, (October 16th, 1939).
Divided out of B.P. 513,466
IMPROVEMENTS IN OR RELATING TO APPARATUS FOR TREATING AND PRESERVING FOOD PRODUCTS AND BIOLOGICAL SUBSTANCES. Claiming apparatus suitable for use in concentration, drying and preservation of products such as liquid or semi-liquid fruit juices, vegetable products (pousses, etc.) protein solutions, blood sera, bacterial cultures, viruses, etc. The apparatus consists of an evaporating chamber sealed against atmospheric pressure and a second closed chamber communicating with the evaporating chamber and containing a heat-regenerable chemical desiccant. The second chamber contains several racks, trays, etc. in thermal contact with the walls on which the desiccant is placed, which provide for the passage of fluid through and round the desiccant. Means for applying vacuum to either or both chambers are included.
44. Flösdorf, E. W. U.S.P. 2,400,748, 21.5.46. Appl. 12.6.43
PRODUCTION OF DEHYDRATED FOODSTUFFS. Satisfactory dehydrated meats, vegetables, etc. are produced by removing 80% of the H_2O by sublimation in vac. from the frozen state, using a good heat-transfer medium and high-pressure steam (source of heat), followed by reduction of the H_2O to 1.5% at 80%.
45. Fisner, E. A. Cereal Chem. 4, 134, 1927
A STUDY OF THE RATE OF DRYING OF WHEAT FLOUR, STARCH AND GLUTEN.

46. Fisher, E. A., Jones, C. R., J. Agric. Sci. 18, 44, 1928, J. Soc. Chem. Technol., J. Ind. 51, 3551 1931.
THE DETERMINATION OF MOISTURE IN WHEAT AND FLOUR. Parts 1 to 4. Deal with the various appropriate methods, including rapid method by use of calcium carbide. Br. Flour Millers R. A. reports 1925 to 1931.
47. Flosdorf, E. W. Reinhold N.Y., 1949, 280 pp.
FREEZE DRYING (DRYING BY SUBLIMATION). Basic Principles. Applications to Medical and Food Products. Changes during process and storage. Equipment. List of U.S. Patents. Large bibliography to each section. Penicillin studies by Sherwood. Specimen mounting in acrylic plastic.
48. Gane. R. U.K. Progress Reports, Denhydration 1943, D.S.I.R. and Min. of Food, VIII, (3), pp. 1-17
GAS-PACKAGING OF DRIED FOODSTUFFS IN TIN-PLATE CONTAINERS. Includes a list of 17 references to D.S.I.R. Low Temperature Research Station reports and records.
49. Gane. R. U.K. Progress Reports, Denhydration 1943, D.S.I.R. and Min. of Food, x (1), pp. 1-27
THE ACTIVITY OF WATER IN DRIED FOODSTUFFS. Water content as a function of humidity and temperature. 28 pages are devoted to tables of data of water relations of dried foods at various temperatures and air humidities.
50. Gentele, J. G. W. B.P. 508,609, (July 4th, 1939)
IMPROVEMENTS IN THE METHOD OF DRYING SUBSTANCES IN VACUO. An improvement in method and apparatus set forth in B.P. 463, 080 (see Vol. 3, No. 1499). Vegetables, berries, eggs, fish, milk and other substances liable to change on heating are dried in vacuo in a closed chamber on metallic supports, which are black or dull on the lower side and are insulated from heat-conducting parts of the apparatus and from heat sources spaced above and below each support, so that the chamber is heated only by radiant heat at a temperature of 200° to 800°C, vapour generated by the substances being cooled by a pump.
51. Gentele, J. G. W. B.P. 509, 676 (November 26th, 1940). Brit. Chem. physiol. Abstr. B. III, 1941, p. 53
IMPROVED PRODUCTION OF DRIED FOOD. Dried foods, comprising prepared dishes of several ingredients (e.g. pea soup with pickled pork, brown beans and pork, steak and potatoes, meat soup, paupers'...

Vacuum pans, etc., placed in insulated containers are dried in vacuum. Heating is effected by exposure of the containers, above and below, to radiant heat from elements at a temperature of 200° to 600°C.

51. Griffiths, Hugh Food Mfr. 1933, 3, 6, 198-201
EVAPORATION IN THE FOOD INDUSTRY. Discussion of the principles on which the large high vacuum vapour recompression system of evaporation is based.
52. Grover, D. W. Br. Food Mfrs. Res. Assn. Res. Rept. No. 2, 31 pp. March, 1947
THE SCIENCE OF DEHYDRATION. The Nature & Possibility of Dried Jellies.
53. Harper, L. K. E. W. Williams Publications, N.Y. 130 pp. 1943
DEHYDRATION OF FOOD. ITS POST-WAR FUTURE.

54. Heinz Co. A BULLETIN OF FOOD DRYING PREPARED BY HEINZ CO. 1942-1941
CONTAINING ABOUT 100 PATENT AND 200 LITERATURE REFERENCES.
Literature Refs.
Analysis and Composition of Dried foods 1-23
Discolouring of fruit in drying and its prevention 24-29
Equipment 30-45
Multiple Evaporations 46-48
Tunnel and Kiln Dryers and Conveyor Belts 49-58
Vacuum Drying 59-68
Canned and the Drying Industry (briefly discussed) 69-70
Fruits 71-96
Prunes 97-103
Vegetables 104-111
Fundamentals of Drying 112-119
Pest Infestation and Fumigation 119-124
Miscellaneous 125-130
Nutrition 131-140
Packaging 140-171
Reconstitution 172, also 73, 92, 118
Standards for Dried Foods 173-183
Characteristics of the Dried Food Industry 184-186
Storage 187-190
Nutrition in Dried Foods 191-194
New Use of Dehydrated Food 195-196
Index of Authors. 197-198

54. Isher-Wood, F. A. U.K. Progress Reports, Dehydration, 1943
D.S.I.R. and Min. of Food, VIII, (1),
pp. 1-14
COMPRESSION OF DEHYDRATED FOODS. Deals with the compression,
properties and storage of dehydrated meat, milk, egg, carrot and
potato. Gives 14 references to the original papers, on work carried
out monthly at the Low Temperature Research Station of D.S.I.R.
56. Isherwood, F. A. U.K. Progress Reports, Denydration 1943
D.S.I.R. and Min. of Food, 1943, VIII (2),
pp. 1-14
PACKAGING OF DEHYDRATED FOODS IN NON RIGID CONTAINERS.
57. Kestner Evap. and Eng. Co. Brochure 1947
A COLLECTION OF REPRINTS FROM VARIOUS PERIODICALS ON:-
Dehydration of Potatoes
Production of Syrups
Rose Hip Powder, spray dried
Soup Powders, spray dried
Dried Fruit Products
Fruit Juice Concentrates
Fruit Preservation
Egg Powder Production by spray drying
Tea Extract
58. Franklin Kidd, J. Nature 153, p.100, 22/1/1944
PRESERVATION OF FOODS BY DRYING. An account of a lecture by
Sir. J. Barcroft, (Chairman of F.I.B., D.S.I.R.) delivered at the
Royal Institution on 26th November, 1943. "Preservation of Foods
by Drying". The lecture dealt with the various advantages of
drying foods, and with individual foods, with general principles and
compressed foods. Comparisons between U.K. and U.S.A. practice.
59. Kidd, F. J. Roy. Soc. Arts., 92, 590, 1944, F.I.B.
Memoir No. 457
DEHYDRATION OF FOODSTUFFS. After a brief review of the subject,
attention is given to the problems which have arisen during the war.
These concern retention of nutritive and storage properties.
Details of progress are given, achieved in the drying of meat, eggs,
green vegetables, root vegetables, potatoes, milk, and fish, dried
soups and of methods of packing and storage.
60. Kiermeier, F. Deut. Lebensm. Rundschau, 44, (39), 1948
CHEMICAL EFFECT OF DEHYDRATION OF FOOD.

61. Kirschbaum, E.

Vorratspflege u. Lebensmittelforsch., 1941, 4, 125. Bull. Int. Inst., Refrig., 1941, 22, 246, (Title only). Chem. Zbl. 1941, 11, 3005. Chem. Abstr., 1944, 38, 4703

REPORT OF THE INTERNATIONAL CONFERENCE ON DRYING TECHNIQUE, held in Berlin on December 12th and 13th, 1940. Describes the most important types of apparatus used for drying grain, flour, paste products, cereals, sprouts, etc., fruits, vegetables (other than potatoes), potatoes, fish, milk and eggs. The physico-chemical principles of dehydration are reviewed.

62. Koniger, W.

V. D. I. Zeit. 79. 32. Aug. 10. 1935
275-31

THE DRYING OF FOOD PRODUCTS - UND FORTFÜHRUNGSMITTEL, INGENIEUR DER NUTRITION, General list of food products and products, with special reference to drying of albuminous and starchy food products; effect of drying on nutritive value; methods of modern dehydration and drying plants for preservation of food products; minimizing waste in food preparation.

63. Krueger, W. C.

New Jersey Agric. Exp. Sta. Circ. No. 463, 1943, Exp. Sta. Rec., 1943, 89, 762

FOOD PRESERVATION BY DRYING. It is considered that drying should be undertaken only when lack of facilities or equipment prevents preservation by other methods. Gives instructions for preparation and drying of suitable fruits and vegetables and for storage and use of the dried products.

64. Van Lasecke, H. W.

Reinholt Publ. Corp. N. Y., 380 pp., 1943

DRYING AND DEHYDRATION OF FOODS. Illustrations of products with some moisture equilibrium curves and nutritive values. Numerous references to each chapter.

It is a book for general reading.

Various fruits are dealt with.

DRYING OF FOODS IN AFRICA. The most important products in the Commonwealth, 80,000 tons a year output.

65. MacPherson, E. W., MacPherson, C. C.

U. S. P. 2,401,493, 4.6.46, Appl. 9.6.45

DEHYDRATION OF FOODS. Food products (fruits, vegetables, etc.) are immersed in aq. NaCl containing a small percent of Na_2CO_3 , then dried in a tunnel, first at 45° and at an air velocity (V) of 4 ft. per second, and finally at a higher temperature and V, followed by cooling prior to packing.

66. McKee, C. C. Paper to Pacific Coast Gas Ass.Tech. Sect. Utiliz.Conf., 24-25, April, 1946; Gas, June 1946, 22, No. 6, 70)
COMMERCIAL DEHYDRATOR. An exhaustive study of problems, design, development and use of food dehydration methods is presented. Devices employed are broadly classed as batch dryers and continuous dryers, the former including compartment and vacuum dryers, and the latter including tunnel dryers as well as conveyor, rotary, and spray dryers. Charts showing yield and drying rate, a table of costs, and a drawing of a standard tunnel type are attached.
67. Magoon, C. I. Scope, Aug. 1948, Food Inds., 18, 3.3.1948, pp. 322-4, 471-4-8
COMPRESSED FOOD. ETAGONE TABLETS.
68. Magoon, C. I. Food Inds., 20, 384-6, 496-8, 1948, U.S. Dept. Agric. Chem. Alstr. 42, 18, 6950, 20/9/48.
COMPRESSION AND STORAGE OF DEHYDRATED FOODS, FRUIT, EGGS ETC. Compression in air packed containers did not have deleterious effect except for wheat flour.
69. Meuche, H. E., Brown Boveri and Co. Elektrizitätsverwertung 19, 1-3, 1944/5, 10pp.
TRANSPORTABLE BROWN BOVERI UNIVERSAL GULF DRYER WITH HEAT RECUPERATION. The incoming air is warmed by the outgoing moist air; the economy in electric power consumption is illustrated.
70. Miller, B. Food Inds. 9 (4) Apr. 1936, 183-6
DRYING FOODS WITH NON-ROTARY AIR DRYERS. Air drying with mechanically operated cabinet, conveyor, truck or tray driers may be carried out in batch or continuous manner, at atmospheric, or less than atmospheric pressures, and between flexible or rigidly controlled temperature limits; properties of materials to be dried play important part in selection of drying equipment; operating cost data.
71. Morris, T. N. Chambers Encyclopaedia
DEHYDRATED FOODS. A review of the general principles and methods of dehydration of foods.
72. Morris, T. N. Rep. 7th Internat. Congr. Agr. Industr. Paris, I. Part II, p. 55, 1948
THE RETENTION OF FOOD VALUES IN CANNED DEHYDRATED AND FROZEN FOODS.

- Morris, T. N. Chapman and Hall, 1947 174pp. 15/-
THE DEHYDRATION OF FOODS. Includes the work done at the Low
 Temperature Research Station during the war.
74. Mrak, E. M. J. Amer. diet. Ass., 1943, 19, 6
DEVELOPMENTS IN DEHYDRATION. Discusses the advantages and
 disadvantages of dehydration, giving tables showing weights of
 vegetables (prepared for processing, canned or dehydrated and puréed)
 obtained from a ton of fresh material, cubic displacement of fresh,
 canned and dehydrated vegetables and dehydration and re-hydration
 ratios for various vegetables, apple nuggets, cranberries, eggs, milk
 and soup. Describes preparation of vegetables, fruits and other
 products (eggs, milk, meat) for drying and procedures such as sun-
 drying, evaporation, dehydration, vacuum-, spray- and drum-drying.
 Losses of sugar from raisins subjected to various drying temperatures
 are tabulated. Deals with the nutritive value of dried foods,
 giving the relative food values of several fresh and dehydrated
 vegetables, and the storage of dried foods with reference to changes
 in quality of Californian apricots during storage in Manila.
75. Musher, A. B.P. 541,004 (November 10th, 1941).
 Brit. chem. physiol. Abstr. B, III, 1942, p. 56
EXPANDED FOOD PRODUCTS. Relates to a method of preparing foods with
 a low starch content (such as vegetables, fruits, meats and fish,
 normally of high water content), so that they will be more readily
 cooked and more digestible. The food is first dried and then
 exploded. It may be cut into smaller pieces and, with or without
 previous cooking, steaming or freezing, fried, e.g. in a tray heater
 at temperatures from 90° to 180° F. (32.2° to 82.2° C.) and at
 atmospheric pressure or under vacuum for a period of e.g. 4 to
 6 hours. Dried material, containing less than about 12 to 15%
 moisture, is then placed in a closed chamber or pressure gun, in
 which the pressure and temperature are raised and maintained for
 time varying from 15 to 45 seconds to 10 to 12 minutes, then the
 chamber is opened to atmospheric pressure and temperature, allowing
 the food material to expand. It is expelled from the chamber or gun
 and, if solid, can be passed into oils or fats or their vapours or
 into atmospheres of nitrogen or carbon dioxide. Examples are given
 of treatment of celery.
- Neogi, S., Rajagopal, K. J. Sci. and Ind. Res. India pp. 119-21,
 July 1949
 The wood, water-soluble, crooking waterways, yields xerone by
 bleaching, dehydroxylation, and extraction, purification by chromat-
 ographic methods and solvent recovery.

77. Peck, W. C. Food Mfr.. 12, 403-7, 1937
DESIGN OF DRYING PLANT FOR THE FOOD INDUSTRY. Continuous dryers, vacuum, air and hot gas dryers. Review and discussion of existing types in food industry's stationary and revolving tray dryers and louvre rotary dryers.
78. Perruche Nature, 184-6, 1947
BRIEF REVIEW OF THE DEHYDRATED FOOD PICTURE.
79. Pleszczek, E. Vorratspflege u. Lebensmittelforsch., 1941, 4, 113., Bull. Int. Inst. Refrig., 1941 32, 242 (Title only)
DIE BEDEUTUNG DER TROCKENTECHNIK FÜR DIE VERSORGUNG DER WEHRMACHT MIT LEBENSMITTELN. A report to the research service conference on drying technique, held in Berlin on December 12th and 13th, 1940. Deals with the importance of dehydration as a method of preservation for army food supplies, the advantages being a saving of tin-plate, economy of weight and space, convenient storage properties, and ease of preparation for consumption of the dried products. Grain, bread (e.g. "Knäckebröt"), meat (e.g. in the form of cooked products), milk and, especially, potatoes, green vegetables, fruit, fermented and cooked krauts, tomatoes and onions were dried for the use of the German army, and the drying of cheese and jam was started. Condensed milk was also distributed. Discusses the time taken for large-scale preparation (trimming, washing, cutting and cooking of fresh potatoes and green vegetables and the time saved by using dried vegetables, and shows that the dried products, when prepared from good quality raw material, properly pre-treated (washed, cut and blanched) and efficiently dried, pressed and stored, can be a good source of vitamin C.
80. Pike, W. E., Farmington, B. Colorado Farm Bull. Col. Agric. Exp. Stn. 4 (No. 4), 10, 1942, Exp. Stn. Record, 88, 849, 1943
PRESERVING NUTRITIVE VALUE IN DRYING FOOD IS GOAL OF PROJECT. Describes a tunnel drier, modified to fit into a portable cabinet and equipped with a gas heater of the radiation type. Cherries, potatoes, corn, beans, peppers, beets and carrots were successfully dehydrated in this apparatus. Analysis of carrots in the carrots showed that the dehydrated product contained nearly 10 times as much carotene per gm. as the fresh material.

CONTROL OF BACTERIA IN DRY FOOD PRODUCTS. Classified dried foods according to type or physical condition of raw materials from which they are made and general physical conditions of manufacture used in processing the raw materials, i.e. (1) dry materials obtained by dry processes (e.g. wheat flour, soy flour), (2) wet materials obtained by wet processes (e.g. dried eggs, powdered milk, sugar) and (3) dry materials obtained by wet processes (e.g. dried fruit, prepared dry cereals, powdered yeast, starch). Discusses certain fundamental principles of microbiological control which must be applied to products in the various groups in order to obtain dried foods of good quality and to prevent spoilage.

PRODUCTION OF PARTIALLY DEHYDRATED PARTIALLY COOKED FOODS FROM CEREALS.

Partial cooking and dehydration are accomplished by the action of heat and pressure, the previously toughened and mellowed grain passing between a pair of heated revolving rollers, maintained at 210-270°F. The flaked material is removed by scraping the surface of each roller by means of a doctor blade.

DEHYDRATION OF FOOD WITH CARBON DIOXIDE. The food is dried in a carrier gas stream containing at least 3% by volume of Carbon Dioxide and heated to a much higher temperature than when air alone is used as the drying medium. The exit gas is dried and deodorized for repeated use. Fluorides, it is suggested as a source of Carbon Dioxide. The process is speedier than others.

DEHYDRATION EQUIPMENT AS APPLIED TO FOOD PROCESSING. A general illustrated description of methods of drying food materials and types of driers used. Driers are classified into (1) batch driers (tray, loft, compartment and vacuum shelf driers) and (2) continuous driers (tunnel, conveyor, rotary, drum, flash and spray driers).

NEW OR IMPROVED PROCESS FOR THE PRODUCTION OF FOOD POWDERS.

The process described consists in mixing corn flour, potato flour, rice flour, arrowroot, or a blend of one or more of such substances, with water to a paste-like consistency, cooking the mixture until the starch gelatinizes, thinning with cold water and sterilizing and spray-drying the product. A flavour may be added.

86. Scott, A. W. Fuel and the Future 1948, 1, 267
See under "DRYING GENERAL".
87. Seltzer, E., Settlemeyer, J. T. New York Academic Press 1949
pp. 399-520
ADVANCES IN FOOD RESEARCH, VOL. II SPRAY DRYING OF FOODS. Detailed
descriptions of most spray dryers. Operational data etc. are given.
A comprehensive review of spray drying.
88. Shumacher Meat and Milk Ind. USSR, No. 1, 100, 1945
Transl. in D.S.I.R. Records 1087
THE DRYING OF ANIMAL FOOD PRODUCTS. Processes known for 1940,
Hormones, Milk. Processes:— Cool to -20° (solid) in freezing mixture.
Removal of water at 100 atm. pressure at -1°; partial vacuum.
Mix with silica gel. Screen.
89. Shuman, A. C., Staley, C. H.
DRYING BY INFRA RED-RADIATION. See under "INFRA-RED".
90. Slade, F. H. Heat and Vent. Engr., 4/1948, 21, (251), 476
MODERN DRYING METHODS. General description. Treatment of
materials (vegetables, meat etc.) Tunnel, spray, freeze, chilling
film, high pressure hot water dryers. Brief descriptions of
processes for coffee, blood, vegetables; gives spray sizes and apparent
densities of spray dried product.
91. Smith, A. J. M. U.K. Progress Report, Dehydration 1943
D.S.I.R. and Min. of Food, X, (3),
pp. 1-44
REPORT ON PHYSICAL ASPECTS OF DRYING AND SOME DRYING DATA CONCERNING
OF FOODS.
 1. Water Transfer from an evaporating surface"
 2. Drying of Solids.
 3. Drying Characteristics of Fruits.
 4. Drying Characteristics of Vegetables.
 5. Drying Characteristics of Minced Beef.
 6. Progressive Drying.Appendix. Fuel Economy in Dehydration.
92. Spindler and Dunbar Food Industries 3/1946, 18, 3, p. 342-4,
466-9
TRICHINAE ARE KILLED @ 120° F.
93. Stateler Food Ind. 1945, 17, 1450-90-4-6
UNIT EMPLOYING RADIATION, CONVECTION AND COMBINATION FOR HEAT TRANSFER
IN DRYING FOODS. Rates of drying are greater than 1 lb. of water
per sq. ft. per hour as compared with less than half pound of water
with conventional truck dryer.

94. Stille, B. Z. Lebensmittel, Untersuch, u. Forsch, 88, (9), 1948
LIMITS OF RELATIVE HUMIDITY AND OF WATER CONTENT OF DRIED FOODS TO AVOID MICROBIAL ATTACK.
95. Strock, C. Industrial Press, N.Y., 1948
HEATING AND VENTILATING ENGINEERING DATA BOOK. 70 pp.
193 charts, 317 tables. Gives the specific heats of about 80 foodstuffs per °F. above and below freezing point.
96. See "SWENSON" under "HIGH FREQUENCY".
97. Sybel, H. Von 2, Ver. Deut. Ing. Verfahrenstechn., 3, 59-62, 1941
THE DRYING OF FOODSTUFFS. A review covering general aspects and processing of potatoes, grains, milk, fish, sausages and eggs.
98. Tiller, F. M., Litkenhous, E. E. Food Industr., 1943, 15 (No. 10), and Turbeville, W. 77
INFRA-RED DEHYDRATION OF VEGETABLES AND MEATS. The results of preliminary investigations of the infra-red dehydration of vegetables, the purpose of this radiant heating being to increase the rate of heat flow above that obtainable by means of ordinary convectional heat transfer. Experimental dehydration of meats (pork and beef) and vegetables (carrots, sweet potatoes and turnip greens) was carried out in an oven with walls of sheet metal, the top being covered with insulating board to restrict air flow and increase air temperature. Vegetables were sliced by machine, to obtain uniform thickness, and meat was sliced by hand. Drying curves for the different products are shown. The relation between thickness and drying time was investigated. Industrial equipment and the design of a commercial oven are discussed.
99. Thompson, J. B., Kocher, R. B., Fritzche, H. W. Arch. Biochem. 15, 41, 1948
THE EFFECT OF COPPER ON BROWNING OF FOODS. Traces of metals account for off-flavour and deterioration of foods. Reactions with proteins etc. have been studied. It is suggested that the copper-protein complexes can promote browning.
100. Titus, H. L. et al Chem. Prod. Nov.-Dec., 1944, 8, (1-2), 3
RETENTION OF VITAMIN-C IN FOODS IN THE PRESENCE OF AN OXYGEN-CONTAINING ATMOSPHERE IN DEHYDRATION.
101. Wright, E. E. Mech. Handling, 33, 532-40, Sept. 1949
CONVEYORS IN THE FOOD INDUSTRY. Illustrated.

101. Zenzes, A.M., Schloessinger, W. U.S.P. 2,432,222, 9.12.47,
B. III, Nov. 1948, 395
DEHYDRATED FOOD PRODUCTS. Food products with high water and low
sugar content. Stabilized with sugar, edible acids, salt etc.
Water removal promoted by addition of Wetting Agents. Colour
preservation by thio-urea. Rapid rehydration.

103. Zimmerman, G.
See under "GREEN CROPS".

FOODS VARIOUS

104. Lidano Co. Denmark Butter, Cheese and Milk Products Journal,
pp. 42-3, Oct. 1950
Dehydrated cheese is reduced to powder which can be reconstituted
with water to normal consistency, or can be used as an ingredient
of other foods. It keeps well.
105. McDowall, F. H., Dolby, R. M. N. Z. J. Sci, Tech., 1942, 24, 53B
Beatson, E. and O'Dea, J. J.
THE COMMERCIAL PRODUCTION OF DRY BUTTER FAT. Recommends the use
of centrifugal separation of melted butter for large-scale production
of dry butter fat and gives an account of the development of the
process. Butter extruded from a bulk-butter piler is melted under
1 lb. steam pressure and pumped to separating cylinder, where some
gravity separation of serum takes place. The fatty portion passes
through a cream-separator, thence through a particularly large
cream-separators. The nearly-dry fat is vacuum-dried, filled into
cans through drip-proof valves and the sealed tins are stored at
temperature of 4° F. (7.22° C.) for crystallization before export.
The separated serum is re-separated twice before being discarded,
the recovered fat being re-treated by the above process. Costs of
processing and saving in storage and shipping space and in transport
costs are outlined. The butter fat is stated to be free from toffee
flavour and has a moisture content of 0.02 to 0.04% copper content
of 0.01 to 0.03 p.p.m. and iron content of 0.02 to 0.15 p.p.m. The
keeping quality is excellent and there is no loss of vitamin A in
processing.
106. Sanders, G. P. Food Industr., 1943, 15(No. 10), 80
NEW WAY TO DEHYDRATE CHEESE. Describes a method for dehydrating
hard cheese, in which the cheese is grated and dried at room
temperature to harden the surface of the particles, so that the fat
will not exude and the particles will not cohere, then finally dried
at a higher temperature in a tunnel or chamber drier. The dried
cheese flakes are compressed into rectangular bars or cakes.

Samples stored at a temperature of 105°F. (40.55°C.) for 5 months showed no significant development of off-flavour or other defect. Treating the bars with 5 layers of cellophane wax and paraffin in solution was found to prevent absorption of moisture and leakage of fat. Some oiling-off was observed in dried flakes stored at temperatures above 82°F. (27.78°C.). The final temperature of dehydration served as a pasteurizing temperature and the dryness of the product prevented mould growth during storage. The flavour of the dehydrated cheese was found to be as good as that of the original cheese. The method of dehydrated cheese and a method of making cheese spread are outlined.

107. Storen, K., Snersrud, T. *Chimic and Ind.*, 57, 587, 1947
In the dehydration of milk for cheese making, there are advantages in the vacuum process and an improved flavour is claimed.
108. Holmes, N.E. Kefford, J.F. *B.I.O.S. Report No.1513*
ANALYSIS OF MILK POWDER FOR CHEESE MAKING. P.1. MILK MILK IS VENTURE
AND SEVERAL TO 10% MOISTURE. LOWER CONCENTRATION GIVES A FLUFFY
dried product. High concentration gives more dense powder.
p.3. Final mixture is roller dried to 3-4% moisture. New roller
dryer by Escher Wyss, Ravensburg, 1946. Mixture picked up by small
rollers and blown off these on to the drum. Diagram. Stated to
give a product more similar to spray dried milk.
109. Anon. *Amer. Miller*, 77, (1), 65, 1949
LOW COST POTATO FLOUR. Process developed by the Eastern Regional
Laboratory, of the U.S. Department of Agriculture. Raw potatoes
are ground in a hammer - mill, sulphur dioxide added to prevent
darkening, and the ground material dried in a standard steam tube
dryer, some dried material being remixed to prevent sticking. After
a second milling the product is bagged.
110. Morey, Kilmer *Cereal Chem.*, 24, 364, 1947
and Solman
RELATIONSHIP BETWEEN MOISTURE CONTENT OF POTATOES AND HUMIDITY OF AIR.
A linear relationship exists between the moisture content and the
absolute humidity of the air. For a moisture content of 14% the
reciprocal of the absolute temperature is a linear function of the
log. of the water vapour pressure. The heat of hydration is
calculated as 10.7 calories per mole of water.
111. Thomas, B. *Z. ges. Getreidew.*, 1940, 27, 7. *Food Industr.*
1940, 12(No.7), 98 (Abstr.), *Food Manuf.*,
1940, 15, 217
THE PROPERTIES OF POTATO FLOUR IN THE BAKING OF BREAD, CAKES, AND
AND CAKES, BREAD AND CAKES, AND CAKES, AND CAKES, AND CAKES, AND CAKES,
quality, and proved to be exceptionally stable when subjected to high

temperatures. Describes a vacuum drying treatment for flour which is to be subjected to long periods of storage in tins. Moisture content was reduced to about 8%. Drying flour retards the hydrolytic liberation of free fatty acids and the fact that vacuum drying sterilizes the flour also contributes to its stability. Oxidative rancidity in canned flour can be prevented by lining the cans with paper or by exhausting air from them before sealing.

112. ——— Milling III 54, 1948
MACARONI MANUFACTURE BRIEF DESCRIPTION.
113. Earle, P. L., Ceaglske, H. H. Cereal Chem., 26, 267-86, 1949
DRYING MACARONI. Study of factors causing checking. The moisture stresses were greater than the thermal stresses. Varying R.H. of surrounding air might cause checking.
114. Earle, P. L., Rogers, M. C. Industr. Engng. Chem., 1941, 33, 842
DRYING MACARONI. The object of the work described was to determine rates of drying used commercially for macaroni and rates which might be expected under various conditions. A controlled humidity drier was used and procedure for drying macaroni and similar products is described. An equilibrium moisture content curve for macaroni at a dry-bulb temperature of 100°F. (37.7°C.) was determined. Constant rate and falling rate of drying periods were calculated, and also rates of drying at high humidities. The rates of drying of sour macaroni and of commercial macaroni products under severe conditions were also investigated. Tests were made on commercial equipment.
115. Hummel, Dr. Oth. Gear. Büdler. Zwill. Schweizerische Hauszeitung 67, (35), 472-6, 27/8/1949
DER TROCKNEN VON MACARONI. An account of the drying of macaroni and similar pastes, in long or short lengths. I. Fundamental drying considerations. II. Drying Apparatus, include tray dryers, continuous band, (wire and shovel), hanging conveyor for macaroni. A rapid initial drying is given for some pastes to dry the outside and so avoid distortion.
116. Mannel, H. Vorratspflege u. Lebensmittelforsch., 1941, 4, 205, Bull. int. Inst. Refrig., 1941 22, 246 (Title only).
BEHANDLUNG DER SAUWURST BEIM TROCKNEN UND RAUCHERN. A report by the research service conference on drying conditions, held in Berlin on December 12th and 13th, 1940, dealing with drying and smoking treatments for sausages. In the natural method, the drying period lasts about 3 weeks, during which time the loss in weight of the products is about 10%; the sausages are then hung in suitable storage rooms until they are smoked in an adjacent cold smoke room after smoking the total loss in weight is calculated to be 35 to 36%. Modifications in the processes of (1) cold air drying,

(1) rapid manufacture (which includes "vacuuming" and other treatments) of products with good keeping properties, and (2) being made for supplying the Army, and (3) hot-smoking are described.

117. Fidler, J. C. U.K. Progr.Rept. Oct.1943, Dehydration,
D.S.I.R. Min. of Food, VII part 1,
pp. 1-12

PRE-COOKED MEAT POWDER, SOUP POWDER, VEGETABLE POWDER, AND MEAT AND VEGETABLE POWDER. Summary of Fidler and Bacteriological properties.

118. Fidler, J.C. Gane, R. Food Manufacture, 20, (8), 277-280,
Davies, R. Mapson, L.W. 1st Aug.1945
Pinder, J.L. Bishop, E.A.
DRIED SOUP POWDERS. The powder was developed for emergency rations. Includes meat, vegetables, yeast, onion and flavouring. Details of formulae, preparation and drum drying process, and precautions to be taken in the drying of the purée. Storage and nutritional properties.

119. Standard Telephones and Cables Ltd. Sherman B.P.597,403
DEHYDRATING LIQUIDS BY ELECTROSTATIC HEATING. Vegetable juices for making soup powder or the like are dried by depositing the liquid on rotating drums which form the electrodes for heating.

BAKING

120. G.E.C. Elect. Times, 18 Mar.1948, Vol.113,
335-336
H.F. BREAD BAKING. A summary is given of a lecture delivered by a representative of the G.E.C. Wembley Research Laboratories, outlining briefly the nature of h.f. heating and explaining how the method of application differs from existing methods used in the baking industry. Estimated costs using h.f. heating do not compare favourably at present with conventional methods.

FASTER BAKING AND DRYING WITH INFRA RED HEAT.
103,72-4, July 5,1947

122. Seville. Baker Perkins B.P.602,402, 15.10.45 B.III, Nov.1948
302

Injection of steam.

COFFEE EXTRACT

123. Anon. Chem. Inds. 66, (1) p.26 Jan.1950
CONTINUOUS HIGH VACUUM BELT DRYER. Designed by National Research Corporation, Cambridge, Massachusetts. Cost, at 1 m.m. pr. is comparable to spray drying at 300°F. Inlet gas temperature higher than drum drying at 25 m.m. pressure. 3 to 5 cents per pound of water removed. Slow increase of costs with increasing size.

124. Dixon, R. A. Food Jan.1947
COFFEE ESSENCES AND POWDERS. Processed by climbing film evaporator and spray drying. Illustr.

125. Heyman, W. A. U.S.P.2,432,759 16.12.1947 B.III,
 Baker Importing Co. Nov.1948, p.395
PROCESS FOR COFFEE CONCENTRATION. Describes recovery of distillates, etc. to restore original flavour, and then vacuum drying at 45°F. to produce a dry soluble coffee.

126. Slade F. H. Chem. Products 13(5), 184 Apr.1950
SPRAY DRYING DEVELOPMENTS. A flow sheet of a coffee spray drying factory (from extraction). Liquor, 200 lbs./hr. at 7½% solids is concentr. in a climbing film evaporator with recovery of volatiles, and spray dried at less than 40-50°F. (It is not stated whether vacuum sprayed). The diagram indicates a vacuum spray dryer.

127. Hatelson, E., Weiss, M. U.S.P.2,431,428, 29.11.47 B.III Nov.1948
 395
COFFEE POWDER. Coffee extract is sprayed under not less than 300 microns pressure into a freeze dryer in which the instantly frozen foam dries to a fluffy powder having the aroma and body of the original coffee. Any combination with milk, cream or sugar may be treated similarly. The extract may be concentrated before drying, but the temperature must be below 20°C. See under "Spray Drying".

128. Slade, F. H. Heat and Vent.Engr. 5/1948, 21, (251)
 p. 480
PREPARATION OF COFFEE EXTRACT POWDER. Steeping, grinding, extract to 7½% solution, climbing film vacuum evaporator to 23% solution and spray dried after mixing with equal weight (dry) of lactose. 7½% concentration for chocolate fillers. 23% for coffee extract liquid.

129. Schwarz, H. W. Industr.Eng.Chem.11/1948, 40, (11), 2028-2033
HEAT SENSITIVE MATERIALS. In a pilot plant the direct 30% extract is de-aerated and concentrated at 10 m.m. pressure. Then sprayed on to a continuous belt dryer at 1 m.m. pressure, scraped off into a trolley, and removed without breaking the vacuum. Drying time is 3-15 minutes at 140°F. For good storage, moisture should be less than 2%. For further account see under "Orange Juice".

EGGS

Sci.Lib.Bibl. Series No.354, 1937

THE DRYING OF EGGS. 54 Refs.

Discovery Mar.1947

EGG IS SPRAY DRIED. Air inlet temperature need not be more than

Anon. Food 1942,11,301

PROCESS AND TECHNICAL DATA. Describes briefly the preparation of spray-dried egg. Discusses its properties, methods of evaluating quality and its imperfections, uses and nutritive value.

153. U.S.Dept.Agric. U.S. Egg and Poultry Mag. 48,96,1942

RESEARCH ON THE DRYING OF EGGS UNDERWAY AT U.S. DEPARTMENT OF AGRICULTURE. A brief account of scientific exploration of facts on which standards for dried egg can be based, and from which improved dried egg products may be developed.

Baggs et al, Favold, H.L. U.S.2,445,299, 13.7.1948, Chem.Abstr.

U.S.Sec.Agric. V.14,18,6960, 20/9/1948

METHOD. Emulsion at p.H. 5.5, spray dry, add sodium bicarbonate equivalent to the acidity, before packaging. This increases shelf life 2.5 times in air or N₂ and 4 times when in Carbon Dioxide. Stability on reconstitution is enhanced.

135. Bartram, M. T. J.Bact.,1943,45,48 (Abstr.)

BACTERIOLOGICAL CHANGES DURING THE DEHYDRATION OF EGGS. Investigations were made of experimentally and commercially prepared liquid eggs and of their dried product, total viable and microscopic bacterial counts being examined. Experimental packs were prepared from good-grade eggs, dried immediately or stored for varying periods under different temperature conditions, and from similar eggs with added rots. There was general agreement between viable and microscopic counts of the liquid eggs, but not of the dried eggs. The viable count of dried eggs was of little value as an index of quality of the batter, but there was an apparent relation between the microscopic count of dried powder and the microscopic and viable count of liquid eggs. Average reductions in microscopic count during drying of experimental and commercial batters were determined. Microscopic counts above 10,000,000 per gm. were not found in dried eggs prepared from good-quality liquid eggs, unless the eggs were subjected to careless handling before dehydration.

132. Bate-Smith, E. C. U.K. Progress Report 1943, Dehydration.
D.S.I.R. Min. of Food, IV, 1, pp. 1-67
DRIED EGG: SUMMARY OF WORK AT THE LOW TEMPERATURE STATION IN
DECEMBER, 1943. Methods of examination of dried egg for quality.
Effects of conditions of preparation and storage. Chemical changes
and baking tests.
137. Bate-Smith, et.al. B.I.O.S. Report, No. 275 p.83
DESCRIPTION OF SPRAY DRYING PROCESS AND THE PACKAGING OF EGGS.
138. Bate-Smith, E.C., Brooks, J. J.Soc.chem.Ind., Lond., 1943, 62, 97
Hawthorne, J.R.
DRIED EGG. I. THE PREPARATION, EXAMINATION AND STORAGE OF SPRAY-
DRIED WHOLE EGG. Describes methods of examination of dried egg,
including scoring for flavour, detection of different types of off-
flavour and determination of solubility, water content, aerating
power, creaming, acidity of ether extract and pH. Comparisons were
made of results obtained with small-scale and commercial spray-driers
and the effect of conditions of drying on initial quality of the
dried egg was examined. The effects of water content and temperature
of storage on the rate of deterioration of dried egg during storage
were investigated. Gas-packing of spray-dried egg and storage of
compressed blocks of dried egg are discussed.
139. Bate-Smith, E.C. Food Manufacture, 20, (3), 284-8,
Hawthorne, J.R. 1, Aug. 1945
TECHNICAL ADVANCES IN THE PRODUCTION OF DRIED EGG. Spray Dried
egg. The deterioration in flavour is related with solubility in
salt solution and fluorescence. Largely due to disappearance of
glucose. Therefore a chemical test for quality is well in sight.
Controlled fermentation to preserve quality. Colour. Sugar Dried
egg, especially for the baking trade. Dehydrated cooked egg has
a nutty flavour. Suitable for food mixes but not for binding
properties. Mixed egg and milk (whey) possibilities.
140. Brooks, J. J.Soc.chem.Ind., Lond., 1943, 62, 137
DRIED EGG. III. THE RELATION BETWEEN WATER CONTENT AND CHEMICAL
CHANGES DURING STORAGE. Dried egg powders having different water
contents were stored at temperatures of 15°, 25° and 37°C and
changes in amounts of orthophosphate, acid-soluble phosphorus and
in acidity of the ether extract were measured. The rate of change
was found to depend on water content. Below 4 to 6% water there
was little change, but above this level the rate increased with
increasing water content. The relation of these results to
commercial conditions of storage is discussed.

141. Brooks, J., Hawthorne, J.R. J.Soc.chem. Ind., Lond., 1943, 62, 165
TRIED EGG. IV. ADDITION OF CARBOHYDRATES TO EGG PULP BEFORE DRYING. A METHOD OF RETARDING THE EFFECTS OF STORAGE AT HIGH TEMPERATURES AND OF IMPROVING THE AERATING POWER OF SPRAY-DRIED EGG. It was shown that rapid deterioration of dried egg during storage at high temperatures could be retarded when certain carbohydrates were added to the pulp before drying. Of the carbohydrates tested, lactose was the most effective. When lactose or sucrose was added to egg pulp before spray-drying, the aerating power of the product was greatly increased.
142. Brooks, J., Hawthorne, J.R. 8th, World Poultry Congress, Rep. Copenhagen, 1, 544.1948
DRIED SUGAR EGG POWDER.
143. Esselen, W.B. et.al. B.I.O.S. Misc.Rept. No.19, pt. 1
SURVEY OF GERMAN WAR TIME FOOD PROCESSING.
p. 84-5. Spray dried at 400 Kg per hour air, temperature 100° to 110°C.
pp. 86-7. Spray dried at 100 atm. pressure. Highest exit temperature 50°C.
144. Fischer, W. Vorratspflege u. Lebensmittelforsch., 1941, 4, 189, Bull.Int. Refrig., 1941, 22, 246
(Title only)
TROCKNUNG VON EIERN. A report to the research service conference on drying technique, held in Berlin on December 12th and 13th, 1940. Gives some account of methods of preparing dried egg products (whole egg, yolk and white) and of the fermentation process for preparing so-called crystallized egg white in China. The packing, storage, keeping qualities and uses of the dried egg products are dealt with. States that the production of dried egg in Germany and other European countries has not been possible hitherto.
145. Gane, R. J.Soc.chem. Ind., Lond., 1943, 62, 185
DRIED EGG. VI. THE WATER RELATIONS OF DRIED EGG. The water relations of dried whole egg were determined at temperatures of 10°, 20°, 30° and 40° over the range of humidity 0.05 to 0.70. From this obtained, it is possible to estimate the water content of dried egg in equilibrium with humidities at any temperature likely to be encountered in normal commercial storage. The data also relate water content to temperature and humidity of the air in commercial drying plants. Denaturation of the proteins, by heating before drying, has only a slight effect on the water relations of the dry product. The method of drying (spray-drying or drying in the frozen state) did not appreciably alter the water relations. The behaviour of dried whole egg was directly proportional to, and about 50% increased from, the relative amounts of yolk and white present in the mixture.

and McFarlane, V.H.

SANITATION PAYS DIVIDEND IN THE EGG INDUSTRY. Emphasizes the importance of hygienic conditions in handling eggs to preserve the quality of the product. Segregation and separate handling of dirty eggs and immediate washing and breaking out under clean conditions is advised. Dirty equipment causes rapid bacterial multiplication. Results are given showing the effect of temperature on the rate of bacterial growth in fresh and stored eggs. Increase in rate of bacterial growth with rise in temperature of liquid eggs was small when good quality eggs were used, but was rapid when the eggs were more contaminated. The quality of dried egg powder produced from eggs of good quality was considerably higher than that produced from inferior eggs.

147. Green, Conrad, Olsen, Chem. Eng. Progr., 44, (6), 591, 1948
 Wagoner Trans. Amer. Inst. Chem. Eng. 591-602, 1948
 Chem. Abs., 42, 20, 7896, 20.10.48

PRODUCTION OF STABLE SPRAY DRIED EGG POWDER. Review of the industry. The Coordinated Research Program. All phases of drying and packing. Heat Balance. B.III 433, December, 1948. A satisfactory egg powder must contain less than 2% moisture.

148. Hauge, S.M., Zscheile, F.P. Science, 1942, 54, 534, Exp. Sta. Rec.,
 1943, 88, 856, Chem. Abstr., 1943, 37, 1202

THE EFFECT OF DEHYDRATION UPON THE VITAMIN A CONTENT OF EGGS.

Samples of fresh liquid and dried eggs, collected at a commercial plant which employed a Hojonnier spray drier, were saponified, extracted with ether and subjected to spectroscopic examination. Determinations of absorption made at 6, 40 Å, to indicate changes in vitamin A content, and at 4,270 Å, to indicate changes in total carotenoid content, gave characteristic curves for the fresh and dried eggs that were identical in the visible region and very similar in the ultra-violet. The drying process caused only small losses of carotenoid and vitamin A, comparable to sampling errors. Losses from both liquid and dried eggs during storage at a temperature of -19°C for 14 weeks were no greater than those caused by drying. Biological assays showed that little or no deterioration of vitamin A took place during dehydration and that the samples on a moisture-free basis had vitamin A potencies of about 44 I.U. per gm.

149. Hawthorne, J. R. J. Soc. chem. Ind., Lond., 1943, 62, 135
 DRIED EGGS. II. THE EFFECT OF MOISTURE CONTENT ON THE INITIAL
 QUALITY OF SPRAY-DRIED WHOLE EGG AND DETERIORATION DURING STORAGE.
 A series of samples of spray-dried egg was prepared on a small spray-
 dryer of the pressure jet type and conditions of drying were varied
 so as to produce samples of different moisture content. Analyses
 of freshly prepared samples showed no correlation between flavour
 and moisture content. Only when the moisture content was below a
 certain critical value was there any correlation between moisture
 content and solubility in potassium chloride or beating power.
 The samples were packed in air in sealed tins and kept at uniform
 temperatures of 20°C, 25°C and 30°C. Deterioration, as judged by
 loss of solubility and beating power, was correlated with moisture
 content. Samples with a high moisture content deteriorated in
 flavour more rapidly than those with low moisture content.
150. S. A. Kaloyereas, Louisiana State University Ice and Refrigeration, pp. 45-47,
 Nov. 1950
 In the freezing of eggs for storage, a slight dehydration is
 necessary, involving a loss of weight of 3%. This is in order to
 prevent cracking. Process and costs are given.
151. Makower and Shaw Ind. Eng. Chem., 1948, V. 40, p. 8, Aug.
 EGG POWDER. Rate of absorption varies as the oxygen pressure and
 is accelerated by light.
152. Mulvany, H. A. Food Industr., 1941, 13 (No. 12), 50
 HOW EGGS ARE DRIED - METHODS AND STANDARDS. 3 Types of driers used
 in the commercial drying of eggs are described. The most satisfac-
 tory is considered to be the spray drier, and operations of the
 cyclone-type of spray drier are considered in detail. Precautions
 necessary in the drying of yolks, and methods of breaking, cleaning
 and candling of eggs are dealt with.
153. Nyrop, J. E. and Akt. B.P. 627,339, 13.3.47
 Niro Atomiser
 PREPARATION OF DRIED EGG. Enzymes are inactivated by heating in a
 rotating perforated worm at 80°C. for 2 min. Then cooled and
 sprayed. The white is not treated like this. Antioxidants, e.g.
 sugar, glycerol, and pH adjustment may be introduced. Improved
 flavour and foaming properties of the heat treated egg.
154. Olsen, Weybrow and Food Ind. 13, 194-5, (12-13), Chem. Abstr.,
 35, 20, 7344, 10.11.47
 THIAMINE STABILITY IN SPRAY DRIED WHOLE EGG. Stability of thiamine
 varies inversely as the moisture content between 1 and 6%. At 10%
 and 2%, thiamine is stable for several months.

155. Prater, A. R. Austr. Jnl. of Applied Science, 1(2), 224-234, June, 1950
EFFECT OF GEL PACKING AND OF HEAT TREATMENT ON THE STABILITY AND QUALITY OF WHOLE EGG POWDER.
- 156 Stateler, E. S. Food Inds., 17, (1), 99-102, Jan 1945
COOPERATIVE RESEARCH SOLVES ARMY EGG DRYING PROBLEM. To dry, whole egg to less than 2% moisture has been a perplexing problem. Formerly not but not stable. Studies by Q.M.C. Laboratories, U.S.A. Chiefly concern bacteriological properties, cleaning and pre-heating. No drying details.
157. Stewart, G.F. Kline, R.W. Proc. Inst. Food Tech., 1941, 2, 48.
 Chem. Abstr., 1942, 36, 845, Food Industr., 1942, 14 (No. 6), 109 (Abstr.)
TRIED EGG ALBUMEN. I. SOLUBILITY AND COLOUR DENATURATION.
 Experiments showed that spontaneous fermentation, which occurs during preparation of dried egg albumen, converts the dextrose present to acid. Removal of dextrose from albumen before drying ensures stability of colour and solubility when the product is stored at temperatures prevailing in ordinary warehouses. Temperatures about 2° to 5°C. effectively prevent this denaturation in unfermented egg albumen. Flake albumen made from unfermented whites was found to denature more rapidly than powdered albumen. Partially fermented, powdered albumen denatured slowly, even at a temperature of 40°C. Under present conditions the fermentation of egg albumen is necessary to maintain stability of colour and solubility in the dry form, if the product is to be stored in ordinary unrefrigerated warehouses for extended periods of time.
158. White, W.H. Thistle, M.W. Canad. J. Res. D., 1947, 51, 194
DRIED WHOLE EGG POWDER. II. EFFECT OF HEAT TREATMENT ON QUALITY.
 Investigations are reported of the effect of heat treatment at temperatures ranging from 26.7°C to 43.3°C. for periods from 3 hours to 7 days on the quality of dried egg powders from 2 Canadian plants. Quality was assessed by determination of the fluorescence, potassium chloride and water values and the pH and refractive indices of the potassium chloride and aqueous extracts. The rate of deterioration was usually greatest on heating for 1 day at temperatures of 43.3°C. and higher, but some change was observed even at 26.7°C. after 1 day. The powders from the 2 plants behaved similarly. Results indicated that egg powder should be cooled within 3 hours of drying to a temperature of 26.7°C. or less, if deterioration in quality is to be prevented.

159. White, T.M.

Thistle, M.W.

DRIED WHOLE EGG POWDER. IV. EFFECT OF MOISTURE CONTENT ON KEEPING QUALITY. Dried whole egg powders were adjusted to contain from 2% to 5% moisture and were held at temperatures ranging from 7.1° to 45.0°C. Quality was assessed by determination of fluorescence, potassium chloride and refractometric values. Temperature was found to be the most important single factor which affects the keeping quality of dried egg, but at all temperatures the rate of deterioration increased with increase in moisture content. To maintain quality during storage and transport, dried egg should contain not more than 5% moisture and preferably 2% or less.

160. Wilson, R.W. and

Food Industr., 1942, 14, (No. 9), 56

Slosberg, H.M.

METHOD DEVELOPED FOR GRADING A DEHYDRATED FOOD. Describes procedure devised for grading spray-dried whole eggs. It is recommended in principle for dehydrated foods other than eggs. The method is stated to eliminate the individual human factor to the greatest possible extent, permitting comparable and reproducible grading.

161. Woodcock, A.H. and

Canad. J. Res. D. 1943, 21, 389

Reid, M.

DRIED WHOLE EGG POWDER. IX. EFFECT OF DRYING CONDITIONS ON QUALITY. Deals with factors which affect the spray-dried drying of whole egg. Liquid whole egg was spray-dried in a small laboratory drier at various rates of flow of liquid egg and at different inlet and exhaust air temperatures. Quality of the powder, as assessed by chemical methods, palatability and baking tests, was progressively improved as the exhaust air temperature was lowered. Inlet air temperatures above 107°C. had a deleterious effect, but lowering the drying temperature too far had an adverse effect on the rate of production.

FISH

162. ----

Meld.fra Sildolje - og - Sildemel
Industriens Forsknings-institut, (6-7),
3-7, 1950, D.S.I.R./5548/C.T., Jan. 1951

THE EVAPORATION OF LIQUID HERRING EXTRACT IN AN ARMILAR DRYER.

163. ----

Sci.Libr.Bibl. Series No.626, 1947
21 Refs.

PROCESSING OF FISH MEALS.

164. ----

D.S.I.R. Report of the Food Investigation
Ed. 1948 p.13

INCLUDES PROCESSING OF FISH.

165. Anon. Engineering 6 July, 1945, 160, 6-8
FISH CURING AND DEHYDRATION PLANT. The kiln used is described and illustrated in detail, including control methods for humidity, temperature etc. Drying is by hot air.
166. ---- B.I.O.S. Report 1481
FISH FOR EIWEISS. Spray Dryer (Disc type) glass tile construction with stainless steel roof. Disc capacity 600 litre water evaporation per hour. Disc 8000 r.p.m.
167. Inst.Tech. Trondijheim Tidsskrift for Kjemf, Bergvesen og Metallurgi No.10 1949, through Food April 1950, pp. 155-6. Food Trade Review. May 1950, pp.14-15
USES FOR FISH PROTEIN. Protein from the wastes of fish products can be rendered tasteless and 6 or 7% can be mixed with bread. Applications for fish flour would be for macaroni, cheese products, pastes and soups. Norwegian workers have simplified the process for extracting fish albumen and have improved the product.
168. ---- F.I.A.T. Report 520
THE DRYING OF FISH PROTEIN.
169. Atlas Engg. Co. Copenhagen Pamphlet 1947
VACUUM DRYING BETWEEN PLATES. See under "VACUUM DRYING".
170. Burton, L. V. Food Industr., 1943, 15(No.12) 80
INFRA-RED SPEEDY FISH DRYING. Gives an illustrated description of a process in which infra-red rays are used to dry shredded salt cod-fish in a continuous operation. Infra-red rays heat the product from the top, while fresh cold air is blown through it from the bottom, as it travels in a fluffy layer about 1 in. thick at 2 ft. per minute.
171. Cooper, D. L. Refrig.Air-Conditi (Canada), 1942, 8 (No.2) 6
ARTIFICIAL DRYING OF SALT FISH. Describes a process for drying salt fish artificially, using a vertical "turbo" drier with unheated axial fans. Return air from the drier, with a small amount of fresh air, is re-circulated through a bank of spray contactors, using lithium chloride solution to remove water vapour, and the dried air is pumped to the drier. The lithium chloride solution can be regenerated for further use. The air in the drier is maintained at a high rate of rotation to prevent surface crystallization by the formation of a thin, hard skin on the surface of the fish. Special provision is made for storing the fish before and after drying.

172. Cutting, C. L. Food Investigation Paper T50/25, 1951,
D.S.I.R./5147/C (to be publ. D.S.I.R.)
INVESTIGATION OF METHODS OF DRYING AND DRYING. Submitted to F.A.O.
Conference, 1950. The possibilities of the artificial dehydration
of fish, in some form or other, using up-to-date mechanical equipment,
are reviewed.
173. Cutting, C. L. Food Inv., Torry R.S. Rec.Mem. No.133,
D.S.I.R./5751/A, Dec.1950
NOTE ON T.S.T. TESTS IN FISH-DRYING TUNNEL ON M.V. "AFRICAN QUEEN"
AT TORRINGTON ON 21-24 AUGUST, 1951. The tunnel is designed for use in
the Tropics. Tests were obtained concerning uniformity and rate of
drying and the behaviour of the product.
174. Cutting, C. L. Food Investigation Advisory Note No.7
Issued Gratis, Nov.1950, D.S.I.R./5141/C
THE SALT CURING OF FISH. The report briefly describes methods of
salt curing fish, what to look for in a well-cured fish and the
signs of poor quality.
175. Davis, H. C. Pacific Fisherman, 46, (6), 59, 1948,
Food Techn., 2, 115, 1948
LOW TEMPERATURE AIR-LIFT FISH MEAL DRYING. A new type of air-lift
unit invented by Terminal Island Sea Foods Ltd. has many advantages
and less fire risk. Meal is light and fluffy and does not cake and
harden on storage.
176. Fougere, H. Fish. Res. Bd. Can., Progr. Rep. Atlantic
Coast Stas. No.34, 1943, p. 15 (Abstr. in
English p. 17), (Sta.exp. Pêche Gaspésie
Commun. No.17)
LE SÉCHAGE ARTIFICIEL DES FILETS DE MORUE SALÉE. An investigation
of the artificial drying of salted cod-fish showed that (1) the
critical temperature is about 77°F. (25.11°C.), expressed in terms of
evaporation temperature, and (2) too rapid drying causes formation of
an impermeable membrane or crust on the surface of the fish, thereby
retarding subsequent evaporation, and slow drying favours formation
of salt crystals on the surface. The most favourable drying condi-
tions are those in which the rate of evaporation is slightly greater
than the rate of diffusion of moisture from within to the surface.
This rate of evaporation can be expressed quantitatively by a time of
1.1 minutes per hour, and represents a constant drying rate for
approximately 7 hours, the time necessary to remove about 40% the
residual moisture of cod-fish. A semi-commercial drier was designed
for the practical application of these results.
177. Hamm, W.S. Butler, C. Food Ind., 1944, 16, 445-7, 489-90
Heerd, M.
FOOD FISH DEHYDRATE WELL.

179. Harrison, J. S. M. Fisheries Res. Board, Canada, No.85,
Dec.1950, Progr.Rep.
MACHINE FOR "SCORCHING" FISH MEAL. Description of a machine for
heating fish meal to temperatures up to 150°C, for producing "scorched"
meal for feeding tests. See issue No.77.
179. Inouye, K. Bull.Jap.Soc.Sci. Fish., 1940, 8, 328
(Abstr. in English)
A METHOD OF DRYING FISH MEAL. A device was devised
in which given conditions of temperature, humidity and rate of
circulation of air may be obtained and controlled. This apparatus
was used in drying the cooked sardine, *Engraulis japonicus*. The
most satisfactory dried product was obtained by drying under condi-
tions of high humidity, i.e. by removing moisture in the fish in
steam at a temperature above the boiling-point of this moisture.
The method described is thought to prevent oxidation of oil and fat,
since no air is allowed to come into contact with the fish during
drying, and, owing to hydrolysis of part of the oil and fat by super-
heated steam, some substances formed in the course of the process
evaporate. Further experiments indicated that this method can be
applied also to the drying of other substances, contact of which with
air during drying is not desirable.
180. Linton and Wood Fisheries Res.Bd. Canada, 6,380-91, 1945
Extensive drying tests on salted codfish along optimum.
Air velocities and temperatures.
181. J.A. Lovern, and Atlas Pressed Fish Dehydr.Process,
Min. of Food June, 1948
DEMONSTRATION OF FISH DRYING PLANT AT COPENHAGEN. Report to the
Ministry of Food. File, 32/1/1.
182. Reay, G. A. Food Science Abstracts, D.S.I.R. 22, (4),
1950
THE PRESERVATION AND UTILISATION OF MARINE FISH IN THE UNITED KINGDOM.
A review of present practice and problems and the application of
research. Oil and Meal production, and Emulsion. Dehydrated
Dehydrated fish meal and applications of albumen substitutes.
The problems of ascertaining the effect of drying conditions on the
biological value of fish meal, and of an economic method for com-
mercial manufacture of such a superlatively fine product as freeze-dried
fish.
183. Cutting, C.L. Reay, G.A. Chem. and Ind. p. 47, 1944
THE DEHYDRATION OF FISH.

184. Reay, G.A. Cutting, C.L. U.K. Progress Report, Oct. 1943,
Dehydration, D.S.I.R. Min. of Food,
III, 1, pp. 1-10
THE DRYING OF FISH BY THE TORRY PROCESS. The preparation of air-
dried, minced, pressed fish, and descript, with diagrams of the
Torry Research Station drying plant. Controls and output..
185. Reay, G.A. Banks, A. Food Investigation Leaflet 11, 1950
Cutting, C.L. D.S.I.R.
THE FREEZING AND COLD STORAGE OF FISH. Excessive drying in cold
storage of portions of the fish is noted by markings on the fish when
thawed, (especially at high temperatures - 8°C. or 15°F.). There is
a loss in quality.
186. Rue, H. E. Food Industr., 1940, 12(No.8), 40
EASY WAY TO TELL WHEN TO STOP DRYING PROCESS. Describes apparatus
and method suitable for estimating the moisture content of material
undergoing a process of vacuum drying. It was applied in the drying
of fish at the canning plant of Ataatntic Coast Fisheries Coy., in
Provincetown, Massachuttes. The angle of repose of a sample taken
from the drier was used as a measure of its moisture content.
187. Shewan, J. M. J. Hyg., (Lond), 44, 193-209, 1945
THE PATHOLOGY OF DEHYDRATED FISH. I. Qualitative and Quantitative
Studies of the Drying Process.
188. Shewan, J. M. Food Inv. Paper No. T50/29, D. S. I. R. /5746/C
Dec. 1950
SALTING, SMOKING AND DEHYDRATION OF FISH. Includes:- Drying and
dehydration, methods of drying, composition of dried and dehydrated
fish, principles involved in drying and dehydration, keeping quality
of dehydrated fish. A bibliography of 106 items is included.
189. Sidaway, E.P. Fish, Res. Bd. Can., Progr. Rep. Pacific
Young, O.C. Coast Stas. No. 56, 1943, p. 4, Mod. Refrig.,
1942, 46, 290
AN AIR-CONDITIONED TUNNEL FOR PROCESSING FISH. Gives an illustrated
account of the construction and operation of apparatus built (partly
from equipment previously used in smoking) for dehydration of Pacific
coast fish. The apparatus comprises a conveyor within a tunnel, in
which the air conditions can be controlled within the limits of
capacity of the appliances involved.

190. Tarr, H. L. A.

Fish. Res. Bd. Can., Progr. Rep. Pacific
Coast Stas. No. 57, 1943, p. 18

CHANGES IN MOISTURE, MICRO-ORGANISMS AND VOLATILE BASES IN DRYED FISH
FISH DURING PROCESSING AND STORAGE. Progress report on a study of
the various microbiological, chemical and physical changes which
occur during production and storage of pre-cooked, dehydrated fish.
Determinations were made of (1) changes in the micro-organism and
volatile base content of fish during processing, (2) moisture,
bacterial and volatile base content of dehydrated fish stored at
different relative humidities, (3) moisture, moulds and bacteria and
volatile bases in dehydrated coho salmon, ling cod and chum salmon
stored at relative humidities between 100 and 65% and (4) moisture,
bacteria and volatile bases in dehydrated ling cod stored at
relative humidities between 30 and 10%. It was shown that signifi-
cant contamination with yeasts, moulds and bacteria can occur during
the preparation of pre-cooked, dehydrated fish. Moulds did not
develop during storage unless the relative humidity was 80% or more
(moisture content about 17.5%) and bacteria did not increase unless
the humidity was 85% or more (moisture content about 19.5%) and
slight increase in volatile base content was observed in fish
stored at humidities at which moulds and bacteria did not develop.
There was a small increase in moisture content at relative humidities
between 10 and 60% and a considerably greater increase at
relative humidities between 70 and 100%.

191. Taylor, H. F.

Food Inds., 8, 608-651, 1936

MEAT DRYER WOULD NOT WORK ON FISH. Due to the glue in the fish
preventing rotation of units by sticking to the walls. 8,000 -
9,000 lb. wet fish in steam heated cylinders (horizontal), 115°F.
20 H.P. motor for each, 27 inch vacuum with 35 ft. barometric
condensers (sea water), and pumps for non-condensable gases.
Vacuum process was recommended for fish for can. reasons, 1. Finest
quality was desired 2. Fish drying is not vacuum or otherwise and
flue gases. 3. Cooking and pressing bad because of loss of
protein etc.

192. Tornes, E.

D.S.I.R. Transl. from Norwegian of a
Visit to U.S.A. April, 1949

PRESS CAKE DRYING. Study of American plant for rendering fish.
Includes (e) presscake drying.
(h) manufacture of fish glue

Describes pneumatic method 250-350°F. Steam tube dryers.
Rotary dryers with fuel oil and recirculation. The pneumatic
dryer was well instrumented with output of 10 tons/hour. (30%
higher nourishment value than with fire tube dryer).
D. S. I. R. / 3452/C. T.

193. Wyk, Van Nature 160, 872, 1947
CRITICAL MOISTURE CONTENT OF DEHYDRATED STOCKFISH. With other foods, reduction of moisture content lengthens storage life. With stockfish there is a sharp reduction of storage life below 8% moisture content. The material discolours and loses flavour. At less than 5% moisture, the storage life is less than 2 weeks; at 16% moisture it is up to 12 months.
194. Young, O.C. Fish Res. Bd Can., Progr. Rep. Pacific Coast Stas. No. 56, 1943, p. 7
 Sidaway, E.P.
THE DEHYDRATION OF FISH. Using apparatus described elsewhere (see Vol. 1, No. 137), procedure was evolved for dehydrating fish which gave satisfactory results. A table shows percentage reduction in weight obtained in the various operations concerned in the dehydration of herring, brill, grey cod, ling cod, red snapper, halibut, salmon and logfish, also total reduction in weight, moisture remaining in the final product and specific gravity of the product. The savings in space occupied by dehydrated fish, as compared with canned fish, were calculated. It was shown that a greater weight yield of protein was obtained by dehydration than by canning of fish. Investigations into the reconstitution of the dried products and storage at different temperatures and in different types of container are being made, as well as simple cooling tests.
- 195

FRUIT JUICE

197. Anon. Food, Feb. 1950, 19, 221, 49-56
CAUTION OF COLOUR. A well illustrated description of the processing of fruit juice. Apple juice and citrus fruit concentrates by triple effect evaporators.
196. Bate-Smith, et. al. B.I.O.S. Report No. 275, p. 60
FRUIT JUICE. Concentrated by Vacuum or Freezing. Concentrated juices must be artificially preserved. Seitz Kieselguhr, for sterilising filter. Apple, Grape, Cherry, Currant. Filtrajel or filter enzyme, for breaking down pectin which holds up particles and makes the juice turbid.
198. Bickel, E. Distillateur u. Liquor fabrik, 50, 474-5, 1937
FRUIT JUICE IN SOLID FORM. Describes the Sisco method, patented in America, U. S. Dispenses with high temperature and vacuum. Apple juice is dried on a special drum to transparent blocks in a few seconds. High speed air at room temperature removes moisture. Moisture in the end product varies between 2.5% to 3.5%. Pectin is recovered as a by-product.

188. Charley, V.L.S. Univ. of Commonwealth Agric. Bureau pp. 176, 1948
Bristol, Long Ashton
RECENT ADVANCES IN FRUIT JUICE PRODUCTION. Reviewed in C. & I.
14 Oct. 1950
199. Cruess, W. V. Fruit Prod.J., 1942, 21, 165
FRUIT CONCENTRATES AND THEIR USE. Reviews recent information
concerning (1) methods for concentrating fruit juices (including
concentration in vacuo or by freezing), (2) preservation of fruit
concentrates and (3) their principal uses. Concentration by
freezing the juice to a slush of ice and juice and then separating
the ice and concentrate by centrifuging or straining gave a product
of rich flavour and aroma, but undesirable changes in flavour
and darkening in colour of the juice occurred during storage at
room temperature. By concentrating the juice to only 50.0 to 55.0
Brix or flash pasteurization in bottles and cans, sealing and
storing at 22.5°C, the rate of deterioration could be reduced,
but the best means of retaining flavour, aroma and colour was
storage at 0.15°F (-17.88°C).
200. Dixon, R. A. Fruit Annual 6 pp. 1947/48
CONCENTRATION OF FRUIT JUICES. By clipping film evaporator.
201. Gilroy, P. E., Champion, F.A. J.S.C. 1.67 (11) p.407-10. Nov. 1948
ALUMINIUM AND FRUIT JUICES. The suitability of alloys of
aluminium with manganese, or with magnesium and of pure aluminium
for storage and transport. They were found eminently suitable
for apples, black currant, and also for citrus juices if sulphur
dioxide content is controlled.
202. Holzcker, R. Food Industr., 1943, 15(No.8), 62.
THE ARTIFICIAL FOOD DEHYDRATING FRUIT JUICES. Outline of process
made in spray-drying and desiccation from the frozen state, as
2 methods of producing dehydrated citrus juices. Spray-drying
should be accomplished at low temperatures and normal pressures
to avoid loss of flavour and destruction of vitamins. A
conditioner must be used to overcome the hygroscopic tendency of
the fruit sugars. The reconstituted juice had a good colour and
flavour and the powder showed no deterioration after 6 months'
storage. The process for desiccation of juice from the frozen
state is described. The product is free from conditioners or
other additions, but is thus hygroscopic and must be suitably
packed to prevent reabsorption of moisture.
203. Ingram, M. Bd. Sci. Industr. Res.
Palestine, Jerusalem, 1948
THE VISCOSITY OF CONCENTRATED ORANGE JUICE.

204. Florsdorf, E. W. Food Inds. 17 1945 22-5, 98, 100
-2-4-6-8
ORANGE JUICE. Better storage properties, less degradation,
better restoration.
205. Florsdorf, E. W. Chem. Eng. Progr. 43 343-8, July 1947
FREEZE DRYING. See under Freeze Drying.
206. Gane, R. Food Mfr. 23 282-7 1948 BIII 286 9, 1948
CONCENTRATION, BY FREEZING OF FRUIT JUICE, VINEGARS, AND CIDER.
Small scale expts. Deterioration aspects.
207. Mass. Inst. Techn. Res. Depts. of Q.M. Contract Projects
Campbell, W. L. 7/42 - 6/43 pp. 2-20 7/43 - 6/44 pp. 3-89
Proctor, B. E. 7/45 - 10/45 3-169
DEHYDRATION OF CITRUS FRUIT JUICES. Three experimental methods for
drying from the frozen state.
(1) Flash Dehydrator.
(2) Injector Dehydrator (flakes in motion) injected on to rolls,
scraped off, broken up and then dehydrated.
(3) Vacuum Tank Dryer.
208. Mitchell, T. Bottler and Packer 23 No. 1 17-18, 1949
B.I. 315 May 1949
REFRIGERATING CYCLE REPLACES STEAM IN CONCENTRATING FRUIT JUICES.
For heat sensitive materials, evaporation temperatures should be
between 40°F and 160°F. As all the condensate is recovered, the
plant may be used for distillation as well as evaporation. Details
of operation.
209. Moore, E.L., Atkins, C.N. Proc. Inst. Food Techn. 160-8, 1945
Wiederhold, E.
MacDowell, L. G.
THE CONCENTRATION AND DRYING OF CITRUS JUICES. Deals with various
methods of drying and compares them. Stabilisers:- 10 examples:
Hexose, corn starch, lactose, citrus pectin, methyl-cellulose,
dried powdered orange pulp, gum arabic and gelatin, with chalk or
soda to counteract acidity. Spray dried orange juice and also
drum dried, are suitable for confectionery, etc., but do not
reconstitute well. A 4 page account of Concentration of
Fruit Juices.
210. Olive, T. R.
FRUIT JUICE. See under "FREEZE CONCENTRATION."

211. Reavell, J. A. Chem. and Ind. 56 618-621 1937
CONCENTRATION OF FRUIT JUICE AND FRUIT DRYING. Description of Kestner Climbing Film Evaporator for concentration. Concentrated juice is then spray dried to a powder. Suitable for many things. Low temperatures are maintained during drying.
212. Sedky, A., Fellers, C.R. Fruit Prod.J., 1942, 21, 136
 Esselen Jr., W. B.
AN IMPROVED ORANGE JUICE CONCENTRATE. Describes methods for extracting juice from oranges and treatment and concentration of the juice. Apparatus for vacuum concentration of juice in presence of sugar is illustrated and tables are given showing the effect of different degrees of concentration on the ascorbic acid content of the fresh juice. It was found possible to prepare beverages from these concentrates having a good flavour and a vitamin C content comparable to that of fresh juice.
213. Shroeder, A.L. and Cotton, R.H. Ind.Eng.Chem. 40 (5)
 803-7, 1949
DEHYDRATION OF ORANGE JUICE. Data on variation of drying rates under different conditions of temperature, pressure and charge. The method of drying from thin viscous films is described for maximum production and quality. Vacuum freeze drying after spray drying. Drying rates for liquid films are at least twice the rates for frozen films storage stability. 7 Data curves, Bibliography. See also under FREEZE DRYING.
214. Schwarz, H. W. Ind. Eng. Chem. 11/1948 40 (11)
 p. 2028-2033
HEAT SENSITIVE MATERIALS. In a pilot plant, 50% concentrate is sprayed on to the walls of the dryer at 5 m.m. pressure and the material adheres to the walls as a viscous film which rapidly puffs up to 3 inches, and is allowed to dry to the required M. content, and scraped off. Dryer is then recharged. Curves representing the equilibrium M. isotherms show that pressures (1-100 m.m.) are much higher than the actual drying pressure (.5 m.m.). Thus there is extremely low rate of water release from the material (anomaly). Conclusion: Nothing will materially improve the drying rate without causing deterioration in quality and appearance. (Methods tried incl. H.F.).
215. Schwarz, H.W. and Penn, F.E. Ind. Eng. Chem. 5, 1948 40 5, 938-44
PILOT PLANT FOR PRODUCTION OF ORANGE JUICE, CONCENTRATE AND POWDER. Flow diagrams. Concentration at 10 m.m. pressure to 50% solids and subsequent drying at 0.5 m.m. pr. to 2% moisture. The 50% concentrate is sprayed on to the walls of the dryer and scraped off. Cost of operation in outlined and design of plant

to produce 5,000 lbs. of orange juice powder per 24 hours is presented, from data derived from pilot plant operation. Difficulties of drying discussed. Illustrations and 5 data curves.

216. Glaser, J.C., Olson, E.W., Food Technology 1, 1, 1/1917 pp. 43-44
Kenyon, A.M.C.
A METHOD FOR THE PRODUCTION OF DRY POWDERED ORANGE JUICE. Orange Juice (11-30%) chiefly sucrose, invert sugar and citric acid. Drying from the frozen state was found to be not necessary to produce a satisfactory powder. Present method is evaporation at low temperature and pressure 1.2 m.m. Hg. w. triple steam ejector., 150 lbs. and heat by infra-red lamps, (film is puffed). The juice fed on to an endless belt all within a vacuum chamber. Packed under Vacuum.
217. Tressler, Joslyn and Marsh A.V.I. Publ. Co. N.Y. 1939
FRUIT AND VEGETABLE JUICES.

GLUTEN

218. ---- Internat. Chem. Eng. and Process Inds.
29 (10) p. 454 Oct. 1948
DRYING. Refers to the Pneumatic Drying of Gluten (as flash drying) with particulars of temperatures, etc. See under "Pneumatic Drying".
219. Lusena, C. V. Cereal Chem. 27 167-78 (1950)
Natl. Res. Lab. Ottawa C.A. 6043, 10/7/1950
PREPARATION OF DRIED NATIVE WHEAT GLUTEN. The washed gluten is dispersed in 0.05 Normal Acetic Acid by centrifuging and lyophilizing the dispersion. The dried gluten is a stable white powder essentially free of starch, and bound crude fat, 8% protein, 0.5% ash and 0.5% acetic acid. Baking tests showed that the material was undamaged. No details of drying.
220. Lusena, C.V., Adams, G.A. Cereal Chemistry 27 130-3 (1950)
Nat. Res. Council, Ottawa
PREPARATION OF SPRAY-DRIED GLUTEN. Directions are given for spray drying gluten dispersed in 0.01 Normal Acetic Acid. The dried gluten retained its bread baking properties.
221. Oxnam, J. S. B.I.O.S. Report No. 1559
STARCH ADHESIVES. P. 12. Gluten is roller dried, 3 ft. by 3 ft., twin, fitted with small knives, 78-85% protein 8% m.
222. Parekh, K. B. B.I.O.S. Report No. 1528
STARCH INDUSTRY IN GERMANY. P. 7. Gluten pressed in a filter press and dried in a drum dryer, steam jacketed and provided with scrapers to prevent sticking.

223. Starr, Byron. Clinton Inds. Inc. Chem. Engng. pp. 92-95. Aug. 1949
MAKING THE MOST OF CORN. Corn gluten 1. Swastered and filtered.
The cake is broken up and dried in rotary steam tube dryers, (for
corn gluten meal) containing 41% Protein.

MEAT

224. ——— Nat. Provisioner, 1942, 106 (No. 22), 12
MEAT DEHYDRATION RESEARCH IS SHAPING NEW FOOD WEAPON FOR WAR.
A brief account of recent progress in the dehydration of meat, with
special reference to moisture considerations and air distribution
in the dehydrator.
225. Anon. Nat. Provisioner, 1942, 107 (No. 1), 9,
(No. 2), 8 and (No. 3), 18
USE OF DEHYDRATED MEAT ARE REQUESTED. NEW NEWS ON MEAT
DEHYDRATION. SUBSTITUTION OF PORK FOR BEEF WOULD MEET NEW
DEHYDRATION PROBLEMS. (1) Expansion of the dehydrated meat
industry in the United States is to be encouraged and requests
for tenders for dehydrated beef were issued by the Agricultural
Marketing Administration to processors, with complete specifica-
tions. Several satisfactory methods of dehydrating beef have
been employed. (2) Work on the problem of meat dehydration is
being carried out by several meat-packers and by the U.S.
Department of Agriculture. Cooking and drying procedures used
depended on the equipment available and character of the meat
being processed. At least 4 drying systems have been developed,
with possibilities of immediate commercial use, and a brief out-
line of these is given. (3) Reports that dehydrated pork is to
replace dehydrated beef for lease-lend purposes. Fat content of
pork in relation to the keeping product of the dehydrated product,
specifications which will be required and suitable equipment are
dealt with briefly.
226. Anon. Nat. Provisioner, 1942, 107 (No. 7), 26
SWIFT AND COY. WILL PRODUCE DEHYDRATED BEEF FOR U.S. GOVERNMENT ORDERS
Beef for U.S. Government orders will be produced according to the
continuous, controlled temperature process developed in the
Chicago plant of Swift and Coy. The process involves pre-
cooking of cubed fresh beef at relatively low temperatures,
followed immediately by grinding and slow drying, the dried
product being packed in sealed tin containers.
227. Anon. Nat. Provisioner, 1942, 107 (No. 9), 12
PROGRESS MADE REVEALS FACTS IN MEAT DEHYDRATION.
A brief account of research in meat dehydration being carried out
at the Beltsville, Maryland, research laboratories of the U.S.
Department of Agriculture. 2 Types of dehydrator are used on
the same product. Pre-cooking is avoided and fresh, raw,

trimmed meat in small pieces is passed through the first dehydrator, a double-drum (Roto-Louvre) drier, in which 45 to 50% of the moisture is removed, and then fried further on trays in a cabinet drier until the moisture content is about 5%. Several other types of processing are being examined and 2 new types of dehydrator are under consideration. Work still remains to be done on cooking and drying temperatures, types of equipment and permissible fat and water content of the finished meat product. The problem of packaging materials other than tin is being considered.

228. Anon. Nat.Provisioner, 1942, 107 (No. 11), 13
SWIFT & COMPANY DESCRIBES ITS PROCEDURE FOR DEHYDRATING MEAT.

Problems encountered in the dehydration of beef or pork as a continuous process are pointed out and the general processing method developed is described, the chief differences in procedure necessary in dehydrating beef and pork being outlined.

229. Anon. Nat.Provisioner, 1943, 108 (No. 4), 10.

SWIFT & COMPANY DESCRIBES PORK DEHYDRATION PROCESS. Gives an illustrated description of equipment for dehydrating pork and of the various operations involved, i.e. (1) selection of sides and boning operations, (2) cutting the meat into 2 in. cubes, (3) pre-cooking, (4) grinding, (5) drying the ground particles in a special rotary drier and (6) packaging, the meat being compressed into tins before hermetic sealing.

230. Anon. Nat.Provisioner, 1943, 108 (No. 2), 13
BELTSVILLE DEHYDRATION WORK ADVANCES ON A BROAD FRONT.

A summary of a report by the U.S. Department of Agriculture on the progress of meat dehydration experiments by the Agricultural Research Administration at Beltsville, Maryland. The meat is boned and trimmed of excess fat, then ground to the proper size, pre-cooked, 2 methods of pre-treatment of the ground meat being described, and dried in different types of drier. The types in use at Beltsville include cabinet or tray, double-drum, rotary vacuum, shelf vacuum and air flotation driers, a large transverse circulation drier (also of cabinet type) and another rotary drier not employing a vacuum; their operation is described.

231. Anon. Nat.Provisioner, 1943, 109 (No. 17), 10

SUCCESSFUL DEHYDRATED CORNED BEEF SAUCE DEVELOPED FOR ARMY. The new dehydrated corn beef hash contains top-grade Army approved and inspected beef that has been cooked in its own fats and juices, pre-cooked shredded potatoes and onions, flavours and spices. The ingredients are prepared, cooked and dehydrated separately by a rapid process and the product is vacuum-packed. It can be reconstituted within 10 minutes after addition of water (hot or cold).

232. Anon.

Food Manuf., 1944, 19, 77

Nat. Provisioner, 1943, 109 (No. 24), 11

RECENT DEVELOPMENTS IN MEAT DEHYDRATION. Deals with the dehydration of meat from the frozen state under high vacuum by the Stokes process and by infra-red radiation. The sublimation process of dehydration was found to be particularly useful in connexion with food products with delicate flavours. Meat dried by infra-red radiation is reported to have good flavour and appears to have good keeping qualities.

233. Anon.

Aust. Food Manuf., 1942, 11 (No. 10), 5

DRY MEATS. PROCESS APPLICABLE TO ALL TYPES OF BEEF MEATS: - MUTTON, BEEF, PORK, ETC. Describes a process for preparation of meat, which was developed by the technical staff of the Metropolitan Meat Industry Commissioner at Melbourne, Victoria, A.S.A., in conjunction with the Council for Scientific and Industrial Research, Food Preservation Branch. To eliminate the labour necessary for boning, meats are pre-cooked in retorts under steam pressure in absence of air to render and eliminate excess fat and to soften sinews and muscular tissues to such an extent that they fall away from the bones, which are then removed by hand. The cooked meat is minced and dried on trays in primary and secondary hot air driers, which are described. The meat is passed through a 5/8 in. sieve to prevent lumping. The final moisture content aimed at is 4%. Before packing, cool air is blown through the meat.

234. Anon.

Food Manuf. 1943, 18, 406

MEAT DEHYDRATION IN NEW ZEALAND. New Zealand is to supply the United Kingdom with dehydrated meat during 1943 and 1944. An efficient plant is in operation in Auckland, production being at the rate of at least 5000 tons annually. Beef only is being handled at present, but the plant can deal with mutton, lamb and bobby calves. Meat is placed in freezing chambers till required, when it is defrosted, trimmed and cut into pieces of about 8 lb., which are sliced. The meat is then scalded, minced and dried on trays in tunnel driers, which consist of 4 sections, each at a different (decreasing) temperature. The dried meat is fed to automatic presses and then packed and cased by the usual methods.

235. Anon.

Food Manufacture 20 (5), 281-2, 1 Aug. 45

MEAT DEHYDRATION RESEARCH. Deals with Circular No. 700, U.S. Department of Agriculture. Deals principally with processing, but includes packaging, storage, chemical and bacteriological changes. 8 methods of dehydration embodying features that had been successful with other materials. The vacuum rotary dryer appeared to embody the most good points, and the meat retained most desirable properties. Other satisfactory processes were freeze drying, drum, air flotation, kettle air rotary and kettle cabinet. Dehydrated raw meat appeared to be a better product than dehydrated

cooked meat. Moisture content less than 10% keeps well in sealed cans, but must be eaten promptly on reconstitution. Other important features concerning dehydrated meat are discussed.

236. Anon. Food Industr., 1942, 14 (No.7), 46
METHOD DEVELOPED FOR DEHYDRATING MEAT. Reviews recent investigations in the United States of America on the drying of meat. Various types of drier used commercially and experimentally are described briefly.
237. Andrews, J. C. Proc.N.Z. Ass.Refrig.Inc., 1942, 10, 74
Newbolt, R. P.
DEHYDRATED MEAT. Outlines factors involved in the successful dehydration of meat and attempts made in New Zealand to reduce the matter to one of practical significance. Describes the method used in a small pilot plant in Auckland for dehydrating mutton, pork, beef and bobby calf, the main problem being the dehydration of mutton. The effects of dehydration on the contents of moisture, protein, fat, ash, vitamins and physical properties are dealt with briefly.
238. Bate-Smith, E. C. Mod.Meat Marketing, 1943, 16, 108.
Mod.Refrig., 1943, 46, 112
DEHYDRATED MEAT-PROGRESS AND POSSIBILITIES. An account of work carried out in Great Britain by the Department of Scientific and Industrial Research on dehydration of meat. The process of air-drying meat is outlined and the importance of the fat content is stressed. The behaviour of dried meat during storage and the preparation of compressed blocks of meat are dealt with briefly. A scheme for scoring dried meat by means of a tasting panel is given.
239. Bate-Smith E.C. U.K.Progress Reports.Oct. 1943
Dehydration.D.S.I.R.,Min.of Food
II.I.pp.1-26
DRYING OF MEAT. General considerations determining drying conditions. Methods of drying and characteristics of the dried product. Nutritive value of dried meat. A list of papers and researches on which the present paper is based.
240. Bate-Smith, E.C., Lea, E.H. J.Soc.Chem. Ind., Lond., 1943, 62, 102
Sharp, J. G.
DRIED MEAT. Describes exploratory laboratory investigations, which led to the recommendation of the following procedure for preparation of dried meat: (1) debone and trim off fat in excess of an estimated 30 to 40% on a dry weight basis, (2) cut into 1 and 1 1/2 lb. steaks, which are cooked till just brown throughout, either in an open-jacketed pan (with minimum addition of water) or in a retort at 1 to 2 lb. pressure of steam.

(3) mince coarsely the cooked meat, which is then spread on wire mesh trays, (4) concentrate cooking li more and add to the minced meat, which is dried in a current of air at a temperature not exceeding 70°C until the moisture content is below 7% (11% on the fat-free basis) and (5) compress the dried meat into blocks to fit, with minimum clearance, into cans, which are hermetically sealed. Packed in this way, the product is stable when stored at ordinary temperatures and readily absorbs water when reconstituted.

241. Bate-Smith, E. C. U.K. Progress Reports Oct. 1943
 Sharp, J. G. Dehydration. D.S.I.R., Min. of Food
 II.2. pp. 1-6

MINISTRY OF FOOD SPECIFICATION FOR DRIED MEAT AND METHODS OF ASSAY.

242. Bate-Smith, E.C. et. al. B.I.O.S. Report No. 275 p.81
LEAN BEEF MEAT IS CURED WHEN 1:1 OF NITRITE SALT (0.5% OF SODIUM NITRITE IN SALT). Dried in Imperial dryer for 2½ hours at 75°-85°C to 30-40% water, then reminced and dried as before. Then smoked in a kiln. Final moisture is 11%, fat 13% and its storage life is 6 months. This life is as good as the life of an English product containing 40% fat.

243. Brooks, J. Haines, R.B. Dep. sci. industr. Res., Lond., Food
 Moran, T. Pace, J. Investig. Spec. Rep. No. 49. 1940
THE FUNCTION OF NITRATE, NITRITE AND BACTERIA IN THE CURING OF BACON AND HAM. A report of investigations under the following headings: (1) estimation of nitrite and sodium chloride, (2) action of heat on nitrite in bacon, (3) nitrite and the fixation in colour, (4) formation of nitrite from nitrate after curing, (5) nitrite, sodium chloride and water in commercial bacon, (6) nitrite, nitrate and flavour, (7) bacterial products and flavour, (8) oxidation of fat and flavour, (9) bacterial flora of commercial pickles and bacon, (10) rate of cooling the carcass and (11) experimental cures (details of small-scale and large-scale experiments). Concludes that the characteristic "cured" flavour of bacon is due primarily to the action of nitrite and a satisfactory bacon can be made using only sodium chloride and sodium nitrite. The experiments afforded no evidence that rapid cooling is detrimental. The direct use of nitrite in curing caused a reduction in the microbial population on the surface and consequently a better keeping bacon.

244. Carlin, G.T. et. al. B.I.O.S. Miscell. Rept. No. 19 Parts 1&2
 Pt. 1. p. 89. short account. Pt. 2. p. 484-5 German regulations for control of dried meat. Pt. 2 p. 434-5 Progress in the production of high quality Dehydrated meat. Inst. für Lebensmittel-Forschung Munich, 28.6.1943.

245. Ede, A.J., Partridge, S.M. J. Soc. Chem. Ind., Lond., 1943, 62, 194-200
IRILL MEAT. IV. THE EFFECT OF SOME PHYSICAL FACTORS ON THE RATE OF DRYING OF MINCED MEAT IN HEATED AIR. Describes a laboratory-scale investigation of the drying of cooked minced beef in hot air under various conditions of temperature, humidity and air speed. The effects of temperature of the meat on quality, and of fat content on rate of drying, were also investigated. Measurements are given of resistance to the flow of air through meat layers of various water contents.
246. Gane, R. J. Soc. Chem. Ind., Lond., 1943, 62, 139
DRIED MEAT. III. THE WATER RELATIONS OF AIR-DRIED, PRE-COOKED BEEF AND PORK. Determinations of moisture were made on pre-cooked, air-dried beef and pork by drying for 4 hours in an air oven at 100°C, determinations being made at relative humidities of 0.10, 0.30, 0.50, 0.70 and 0.90 at each of the temperatures 0°, 10°, 37° and 60°C. Water contents were found to vary with temperature in a normal manner up to a relative humidity of 0.4 but at higher humidities the water contents were approximately the same at the different temperatures studied.
247. Hankins, O. G. U.S. Dept. Agric. Circular 706. 1944
 Better storage properties, less degradation better reconstitution.
248. Kraybill, H. R. Canning Age, 1942, 23, 581
 Industr. Engng Chem., 1943, 35, 46
DEHYDRATION OF MEAT. Discusses the development of methods of dehydrating meat which have resulted in satisfactory and acceptable products. Describes the pre-treatment of meat and different types of dehydration equipment, including warm air, vacuum, drum and gas driers. Factors which affect the rate of drying in air, F.S.C.C. specifications for dehydrated beef, 2 commercial processes (rotating drum and tunnel belt conveyor driers) for dehydrating beef and the dehydration of pork are dealt with.
249. Kraybill, H. R. Proc. Inst. Food Tech., 1943, p. 90
THE DEHYDRATION OF MEAT. Factors affecting the rate of drying in air, particularly the presence of fat, are discussed. Methods of pre-cooking and types of drier used are given. A process carried out at a low temperature is slower, but the product is better. Keeping qualities and nutritive value are dealt with.

250. Lobanov, D. I.

Obshch. Pitanie, 1941, 9 (No.-2), 25.
Chem. Zbl., 1941, 11, 2268. Chem. Abstr., 1944,
38, 2132

NEW KIND OF MEAT CONCENTRATE. (Transl. title). The usual meat powders are considered to be inferior meat concentrates, since the collagen of raw meat remains unchanged after drying, and cooking before drying transforms it into a gluten gel that agglutinates the muscle and acts as a layer impermeable to water, thus preventing softening of the meat during the preparation of food. Skripkin succeeded in avoiding this drawback by special treatment (not described) of the meat before drying. The final product contained 10.5% water, 53% nitrogen-containing substances, 9.9% nitrogen-free substances, 20.3% fat and 8.4% ash. It is claimed that it can be kept for over 2 years at room temperature without an air-tight seal, and can be made into a tasty, goulash-like dish by boiling in water for 10 to 15 minutes.

251. Macara, T. J. R.

J. Soc. chem. Ind., Lond., 1943, 62, 104

DRIED MEAT. II. THE GROWTH OF MOULDS ON DRIED MEAT. An account of an investigation of conditions of temperature, relative humidity and water content which permit the growth of moulds on air-dried, pre-cooked meat of standard quality. Results indicated that the minimum relative humidity at which mould growth occurs is slightly below 75%, corresponding to a water content of 10% in dried meat containing 40% fat. This minimum value was not altered significantly for temperatures between 10° and 37°C. The incidence of mould growth in experimental samples received from overseas was in accordance with laboratory findings. Determinations were made of the rate of uptake of water during the equilibration period in some samples.

252. Moran, T.

Dep. sci. industr. Res., Lond., Rep. Food
Invest. Bd. 1938, p. 34

DRIED MEAT. Reports that meat winders, and dried rapidly at ordinary temperature in vacuo over calcium chloride retains its fresh colour and flavour and re-absorbs water, so that it is soft and elastic when cooked. Solubilities of proteins of meat dried by this and other methods are compared.

253. Morgan, Agnes F.

U. S. P. 2,457,063 21 Dec. 1948

Watts, Betty M.

Chem. Abstr. 43, 1880. 1949

DEHYDRATED MEAT SCRAPPLE. A method of preparing finely ground, dehydrated meat with keeping qualities is offered. The meat is mixed with water, cereal and condiments. Certain cereals have anti-oxidant and rancid inhibiting properties which maintain the meat at its full edible and vitamin value.

254. Noel, W. A. to U. S. Sec. Agric.

U. S. P. 2,406,395 27/8/1946

DEHYDRATION OF MEATS CONTAINING FATS. Granular meat is dehydrated in a continuous process by use of a stream of dry gas.

255. Oldham, H.G. Schlutz, F.W. J.biol.Chem., Proc. Amer. Soc. biol. Chem., 1941, 140, xcix
THE EFFECT OF HEAT ON THE AVAILABILITY OF THE IRON OF BEEF MUSCLE.
 Report of experiments in which groups of rats were fed (1) oven-dried beef muscle and ferric chloride, (2) vacuum-dried beef muscle and ferric chloride and (3) oven-dried and vacuum-dried beef muscle. Haemoglobin determinations were made periodically. The same amount of haemoglobin formation was observed when the supplement was oven-dried beef as when it was ferric chloride. Significantly less haemoglobin formation occurred when vacuum-dried beef was fed.
256. Pearce, J. A. Canad. J. Res. D, 1943, 21, 394
THE DEHYDRATION OF PORK. Describes studies of 4 pre-processing and 3 drying procedures for the dehydration of pork. The best product resulted from cooking in an open steam-jacketed kettle, followed by slicing and tunnel-tray drying in 4 hours or less with a tray load of 2 lb. per square foot. Little difference in quality of the product was observed when air velocities of 700 to 1100 ft. per minute over the trays or initial stage temperatures between 70° and 80°C and final stage temperatures between 55° and 70°C were used. Pork, when dried to a moisture content of 3 to 4% in less than 4 hours, still retained a high percentage of the thiamine present in the raw meat, showed no fat deterioration when assessed by peroxide oxygen determinations and on reconstitution had a palatability rating approximately equal to that of the initial cooked material.
257. Pearce, J. A. Food in Canada 8 (7) 24, 1948
DEHYDRATED ANIMAL PRODUCTS. I. PORK AND CHICKEN. A two stage process for pork in a tunnel dryer is described. Temperature conditions are given and compression into blocks facilitated by addition of 1% starch solution. Similar process conditions are described for poultry.
258. Powell, R. W. Trans. Faraday Soc. 39 (2) 311 1943
THE INFLUENCE OF SURFACE FILMS OF OIL ON THE EVAPORATION OF WATER.
 This aspect may have a bearing on the rate of drying of meat.

259. Ritchell, E. C., Piret, E. L., *Industr. Engng. Chem.*, 1943, 35, 1189
Halvorson, R. O.

DRYING OF MEATS. RATE OF DEHYDRATION OF UNCOOKED CURED GROUND MEATS.

Investigations are reported of the air drying under various conditions of samples of uncooked cured meat (pork and beef) to form products having properties similar to dry (or summer) sausage. The rate of drying was materially affected by handling operations and temperature conditions, which may cause the fat to film over the material. Compared with the usual dry sausage manufacturing operations, shorter times of drying were necessary to obtain a product containing 25 to 30% moisture. This was particularly true when the material was dried in the form of small cylinders. Products were similar in colour and palatability to the usual dry sausage, but small particles did not adhere to form a solid mass and larger samples (4 x 1/2 in. cross-section) were required to obtain solid, firm products. Observations made over a period of a year indicated that the keeping qualities and bactericidal properties of the dried products were satisfactory.

260. Stateler, E. S. *Food Industr.*, 1942, 14 (No. 10), 47

SWIFT MEAT MEAT DEHYDRATION ON A PRODUCTION BASIS. Describes the process used by Swift & Co. for dehydration of large quantities of beef. Meat from refrigerated storage is cut into cubes, pre-cooked with a little water, cut into smaller pieces and dried at a controlled temperature in a rotating drum drier, heated air being discharged through vents into the drying chamber and forced through the meat mass to maintain a granular structure in the final product, which contains less than 10% moisture. The construction of the dehydrating unit is described and illustrated. The dried meat is packed under pressure into air-tight containers and sealed under vacuum. Precautions required to stabilize the fat during dehydration of pork and procedure employed for drying pork are noted with it is advisable to add an anti-oxidant to pork.

261. Stateler, E. S. *Food Industr.*, 1942, 14 (No. 11), 52

DEVELOP DEHYDRATING METHOD FOR SMALL PLANT. Describes a method devised in the Griffith Laboratories for dehydrating pork, which is suitable for a small plant. It is proposed to use the method also for beef, veal, lamb or mutton. The method is at present in the experimental production stage and consists in grinding and mixing, trimmed lean meat, adding salt (1% within 24 hours), chloride and fragrant powder and curing at a low temperature for 12 to 15 hours, packing the ground mixture into a block, then covering, cooking, preferably in a steam bath, hanging in the cooler overnight and then re-grinding and drying, either in a smoke-house or at a central plant, to a moisture content of about 2 to 10% (with fat content 32 to 40%), then packing under pressure in air-tight containers sealed under vacuum. Storage tests over a period of 2 months revealed no development of rancidity or loss of quality in the pork.

242. Swift & Co. Food Manuf., 1943, 18, 8
PREPARATION. A short, well illustrated description of the method for dehydration of beef developed by Swift and Coy., the stages being (1) feeding of boned meat into a rotary cutter, (2) cooking with mechanical agitation, (3) conveying to grinder by helical conveyor, (4) fine grinding of pre-cooked meat, (5) drying of the granular meat in a rotating drum drier and (6) conveying in trucks to the packaging machinery. Nutritional and keeping qualities of dehydrated meat are discussed and methods of stabilizing the fat of beef and pork are described.

Whitmore, R. A., Pollard, Food Res. 11 419-24, 1946 B.III.185 7.1948
Kraybill and Elrenjam
VITAMIN CONTENT OF DRIED MEAT.

Whitmore, et. al. Puerto Rico Food Res. 13 19-28, 1948, B.III, 185,
Agric. Expt. St. Rio Piedras July, 1948 Chem. Abstr. 42 18,6952,
20.9.48

PACKAGING DEHYDRATED MEAT. In air, nitrogen, vacuum. Types of package.

265. Zarotschenzeff, M. T. Mod. Meat Marketing, 1943, 16, 61
Food Manuf., 1943, 18, 127. Ice &

DRIED MEAT. Notes on a display in New York by M.T. ZAROTSCHENZEFF of meat products dehydrated at high and low temperatures, including corned beef and fresh beef, pork and lamb.

MILK

Process General

266. --- Food Aug. 1936 8 pp.
THE SPRAY DRYING OF MILK. A short, well illustrated description of the new plant of Appin and Barrett Ltd. Wellington for drying the skim milk from outter making. Preconcentrated before spray drying.

267. --- Food Investigation 1948 L.S.I.R. p. 1
RESEARCH ON THE DRYING OF FOODS. A short description of research being carried out at L.T.R.S. on the above reaction in relation to the drying of foods, where reaction takes place in the dry state.

--- F.I.A.T. Report No. 257
DRIED MILK MANUFACTURE.

269. ---- B I.O.S. Report No. 275 p. 87
SKIM MILK CONCENTRATED TO 73%, WHOLE MILK TO 78-81 BY VACUUM.
 Spray dried, low pressure jets of liquid, on which hot air at 350°C and 47 inch water gauge is blown, giving drying temperature of 80-90°C and exit powder at 40-50°C. Milei. From dairy residues of skim milk, for replacing egg in home, baking, and food industries. A long description of process
270. ---- U.S. Q.M. Food and Container Inst. Cttee.
 on Food, Research, Sept. 1948
 Ref. No. 7 Equations and Bohrs' data
 Ref. No. 8 Review of literature and bibliography.
271. Allen, L. A. Hannah Dairy Res. Inst. Bull. No. 3, 1932
THE PROPERTIES OF MILK IN RELATION TO CONDENSING AND THE DRYING OF WHOLE, STERILIZED MILK AND WHEY. Sweetened and unsweetened milk is condensed in evaporators. Equipment for drying -
 Roller - Just Hotmaker
 Vac. Roller - Passburg.
 Spray (after precondensing)
 - Merrell Soule (jet)
 - Krause (centrifuge, disc. above)
 - Kestner (Disc (below))
 Dough Drying - Precondensed and dried on Trays.
 The book deals mainly with biological aspects.
272. Anderson, E. B. C. & I. 18 March 1950 pp. 203
THE POW-MILK'S BENEFACTNESS. Filtered milk 150 g.p.h. dried from 26% solids. Spray from 40% solids (more soluble in cold water and more costly). Roller process is considerably cheaper and not for infant feeding; the product seems to be preferred, although there seems to be little scientific evidence for this preference.
273. Stamberg, O. E. and Bailey, C. H. Food Res., 1940, 5, 275
DENSITY OF DRY MILK SOLIDS. A method was developed for determining the density index of particles of dry milk solids prepared by the spray and roller processes. Particles of dry milk solids, containing not more than 1½% fat, made by the spray process were found to vary in apparent density owing to occluded air cells, but practically no air cells were observed in particles made by the roller process. Commercial dry milk solids made by the spray process varied widely in density index.

FILM-DRYING PROCESS AND APPARATUS. Relates to a method for drying liquid food material (e.g. milk) spread in a film on an internally-heated drum, which is provided with a casing extending over the greater part of the drum surface. The drum is heated internally to a temperature above 100° C. A jacket of rapidly flowing air or gas is provided round the drum, the air or gas being drawn through a comparatively small clearance space between drum surface and casing at a velocity relative to the drum of at least 10 feet per second. The amount of air used is at least 6 lbs. per lb. of water evaporated from the film.

275. Crocker, W. P. J. Soc. Dairy Techn. pp. 110-14 Jan. 1950
Paper on the history, production, composition and manufacturing precautions of condensed milk.

276. Crossley, E. L. Food Manuf. 1939, 14, 358
MILK POWDER-THE MODERN DEVELOPMENTS. Reviews some of the latest developments in the manufacture of milk powder with reference to the roller-and spray-drying processes, design of machinery, causes and reduction of high bacterial counts, improving keeping quality in storage and nutritional value. Essentials for successful storage are an air-tight container, low temperature and low humidity. Keeping quality can be increased by storage under vacuum or under a neutral gas, e.g. nitrogen.

277. Edeling, C. Milchwissenschaft 1 & 2 88-95 1947
THE THEORY AND PRACTICE OF SPRAY DRYING AND ITS APPLICATION TO THE MILK INDUSTRY.

278. Findlay, et. al. J. Dairy Research 14 165, 1945
THE USE OF WET-CLIMATE IN SPRAY-DRIED WHOLE MILK POWDER.

279. Gagstatter, H. Ostmark, Milchw, Ztg, 1939, 46, 196
Chem. Abstr., 1939, 33, 5925
KASCHG. A PERSIAN DRIED MILK (transl. title). Describes the manufacture of kaschg by evaporating to half its volume skim milk or buttermilk over a small fire and completing the drying in the sun. The product is in the form of hard lumps or short sticks. Its composition is between that of European dry milk and spray-dried buttermilk.

280. Gane, R. Dep. sci. industr. Res., Rep. Food Invest. Bd. 1939, 16-19)

WATER RELATIONS OF MILK POWDER. The behaviour of milk powder at 10%, 40%, and 60% relative humidity (R.H.) is described. A relation of moisture content was found for each. When in equilibrium with 40% humidity (40 R.H.), the moisture content of roller-dried is greater than that of spray-dried milk powder. The effect of the presence of lactose is described.

281. Gray, C. E. Proc. Inst. Food Tech., 1943, p. 52
SPRAY AND ROLL-DRYING METHODS AND EQUIPMENT. Description of processes and apparatus used in the roll-drying, including vacuum roll-drying, and spray-drying of milk powder. In the roll method, the drier is a revolving cylinder, heated from inside. In the spray method, the liquid is finely divided and drying is almost instantaneous.
282. Heath, B. V. Chem. Eng. and Mining Rev., (Austr.)
20 131-2, 5 Jan. 1928
DRYING MACHINERY FOR DAIRY PRODUCTS. Description and diagram of the "Buflovac" vacuum concentrator, and description of spray drying. No data.
283. Hinginbottom, C. J. Dairy Res. 15 277 1948
THE BACTERIAL QUALITY OF BRITISH SPRAY-DRIED MILK POWDER.
284. Hunziker, O. F. La Grange, Ill. 6th ed. 1946
CONDENSED MILK & MILK POWDER.
285. Jack, E. L., Henderson, J. L. Food Industr., 1942, 14 (No. 3), 50
PREVENTING OFF-FLAVOURS IN DRIED WHOLE MILK. Investigations concerned with the drying of whole milk by the "Buflovak" atmospheric drum drier showed that a satisfactory flavour could be maintained for over 2 years if the milk was pre-heated for 15 minutes at a temperature of 175°F ($79-44^{\circ}\text{C}$); control samples which were pasteurized at 142°F (61.11°C) for 30 minutes could be kept satisfactorily for only 2 to 6 months. Additions of "Avenex" No. 7 (2 to 3% of milk solids) or of "Avenol" (0.5% of milk solids) and ascorbic acid (0.2% of milk solids) prevented the development of oxidized flavour in dried whole milk for about 8 months.
286. Knock, C. Paul Parey, Berlin 1928
DAIRY PRODUCTS & LACTATION. (The drying of colloidal liquids with special reference to milk). A critical discussion of the apparatus for large scale drying of fatty and protein materials described in the general and patent literature.
287. Kronberg, N. M. B.P. 517,086 (January 19th, 1940)
IMPROVEMENTS IN AND RELATING TO THE PREPARATION OF DRIED MILK AND CREAM. Describes a process for the production of dried milk product containing active lacto-bacteria which, in which a culture of the bacteria in a medium other than milk (e.g. aqueous inverted cane sugar solution) is added to skimmed milk, unskimmed milk or cream and the mixture is evaporated to dryness by a spray process. The milk or cream may be partly evaporated before addition of the bacterial culture. During spray drying, the milk particles may be electrically charged.

THE STORAGE OF DRIED MILK.

289. Lonergan, G. P., Bristol Co. Ind. Eng. Chem. 28 p. 1264, Nov. 1936
AN AUTOMATIC PROCESS IN POWDERED MILK MANUFACTURE. Spray-dried
unconcentrated skim milk. Accurate heating of the pre-concentrated
liquid. Storage 170°F. Preconcentrator 161°F. Spray 3000 lb.
sq. inch spray nozzles, into filtered hot air. Explanation of the
powdered milk drying process and application of Bristol's
apparatus for controlling temperature at outlet of final heater.
290. McCann, R. J. Dairy Sci., 1943, 26, 716 (Abstr.)
PAST, PRESENT AND FUTURE OF DRY MILK. Outlines the development
of the production of dry whole milk and other dry milk products and
present requirements of dry milk.
291. Manus, L. J., Ashworth, U. S. J. Dairy Sci., 31 517, 1935, 1948
THE KEEPING QUALITY, SOLUBILITY AND DENSITY OF POWDERED WHOLE MILK
IN RELATION TO SOME VARIATIONS IN THE MANUFACTURING PROCESS.
1. Keeping Quality. II. Solubility and Density.
292. Mattick, et. al. J. Dairy Research 14, 116, 1945
THE EFFECT OF TEMPERATURE OF PREHEATING ETC. ON THE KEEPING
PROPERTIES OF WHOLE MILK POWDER, SPRAY-DRIED BY THE RESINES, FRANGE
AND GRAY-JENKINS PROCESSES.
293. Maximov, N., Favstova, V. Molochno-Maslo del' naya Prom., 1939,
6, 2, 327 (No. 6), 5. Dairy Sci.,
Abstr., 1941
MOISTURE EQUILIBRIUM CURVES FOR DRY MILK (GROSS). (Title only.) Results
obtained with whole spray-dried milk and with separated spray- and
roller-dried milks are presented in a series of curves. The
hygroscopic nature of dried separated milk and the need for its
proper storage are stressed.
294. Mohr, W. Vorratspflege u. Lebensmittelforsch.,
1941, 4, 196. Bull. Inst. Refrig., 1941, 22,
246 (Title only).
TRUCKENBEHELT IN DER MILCHWIRTSCHAFT. A report of the research
service conference on drying techniques, held in Berlin on
December 14th and 15th, 1940, dealing with dehydration problems in
the dairy industry. Since dehydrated milk and milk products are
prepared during periods of high milk production in excess for use
during periods of scarcity (i.e. from September to March), it is
essential that these products should be such that they can be
stored for at least 6 months without deterioration in quality.

Recent work in Germany on the development of technical equipment for production of milk powder from whole or skimmed milk is reported. Using a roller-drier system, a finely soluble (up to 100%) powder can be prepared. Factors which affect keeping quality of the dried products, such as the action of metals, humidity of the storage room and method of packing, are discussed, as well as the production of compressed blocks of milk powder. The drying of other products such as casein and whey are also dealt with briefly.

295. Perry, R. L. C.I.O.S. Report 30, 99
DEUTSCHE A.G. FÜR MISCHE. P.A. Details of Spray-Drying of whole milk: diagram of plant. Jet velocity, etc., are given.
296. Scott, A. W. Engineering 134, 627-8 (1932), Nov. 25
THE CONDENSING AND DRYING OF MILK. A brief account of extensive experiments on spray-drying.
297. Scott, A. W. Engineering v 134 n 3489 Nov. 25, 1932
CONDENSING AND DRYING OF MILK. Review of Bulletin n 4 of British Dairy Research Institute; price 4s.6d, on Engineering aspects of Condensing and drying milk.
298. Scott, A. W.
See under "SPRAY-DRYING".
299. Sharp, P. F., Doob, H. Jr. J. Dairy Sci., 1941, 24, 679
EFFECT OF HUMIDITY ON MOISTURE CONTENT AND FORM OF LACTOSE IN DRIED WHEY. Investigations on samples of whey dried by various methods indicated that dried whey in which crystalline - lactose is present as a solid phase contains less water when in equilibrium with an atmosphere of constant relative humidity below 65% than dried whey in which - hydrate is the solid phase. This is accounted for largely by the molecule of water of crystallization in -hydrate crystals. Stabilized dried whey did not absorb excessive amounts of water until the relative humidity exceeded 40 to 50%. Temperature had no marked effect on the equilibrium moisture content of samples exposed to constant relative humidity, but equilibrium was attained more rapidly at higher temperatures. If an appreciable amount of lactose in the glass state was present at relative humidities between 30 and 50%, whey first absorbed and then rejected water. This process was accompanied by crystallization of solid lactose, so that crystallization of -lactose may occur at room temperatures. At relative humidities of 65% and above, crystalline-lactose in dried whey was converted to crystalline -hydrate. The lower the percentage, of lactose in the dry matter, the greater was the equilibrium moisture content of dried whey at constant relative humidity.

300. Webb, B.H., Bell, R.W. J. Dairy Sci., 1941, 24, 535 (Abstr.).
THE EFFECT OF FLASH FORE-WARMING UPON THE HEAT STABILITY OF EVAPORATED MILK. Investigations showed that (1) flash fore-warming of skim milk at temperatures between 100° and 120°C caused considerable increase in heat stability of the evaporated product as the fore-warming temperature was raised and heating at temperatures between 120° and 155°C improved stability further, (2) flash fore-warming of whole milk up to 120°C did not improve the heat stability of the evaporated, homo-genized product, but raising the fore-warming temperature from 120° to 155°C caused a sudden increase in heat stability. The heat stabilities of evaporated skim and whole milks, when flash fore-warmed to their optimum temperatures, could be increased 2 to 6 times. Practical applications of these results in reducing the use of stabilizing salts in the manufacture of evaporated milk and in increasing the amount of milk solids in cans of evaporated milk are discussed.

301. Webb, B.H., Hufnagel, C.F. Food Industr., 1943, 15 (No.9), 72
COMPRESSION SPACE-DRYED MILK TO SAVE SHIPPING SPACE. Presents results showing the effects of compression and of jolting on the quality of spray-dried skim and whole milk. Milks subjected to different manufacturing conditions may vary widely in their compression characteristics. The distinctive features of various types of container are shown.

302. Winhuisen, W. B.P. 528, 154 (October 23rd, 1940).
 Brit. chem. physiol. Abstr. B. I. 1941, p. 50
IMPROVEMENTS IN AIR-SPRAYERS TO EVAPORATING APPARATUS. Liquids such as milk which produce foam and/or become thick, after passing through vertical tubes of a calandria, come in contact with vanes rotated by impact which direct the liquid tangentially against the wall of the chamber, whence it is removed through outlets placed slightly above the level of the vanes. The wall of the chamber is thus lined with liquid held in place by vertical action, and the vapour is drawn off inwardly through the vanes.

Whey

303. Comelli, H. B.P. 535, 050, (March 27th, 1941)
 Brit. chem. physiol. Abstr. B, III. 1941, p. 160
PROCESS FOR THE MANUFACTURE OF A DRY FODDER FROM WHEY BY CONCENTRATION. Dry fodder is prepared by concentrating whey to 1/5th of its volume, adding calcium phosphate, bone meal and ethyl alcohol and continuing concentration to 1/12th or 1/15th of the original volume.

304. Jack, E.L., Wasson, A.J. J. Dairy Sci., 1940, 23, 525 (Abstr.)
SOME PROPERTIES OF DIFFERENT COMBINATIONS OF WHEY AND OTHER MATERIALS WHICH IMPROVE ACTIVITY ON THE ATMOSPHERIC DRUM DRYER. Studies were made of the properties of different combinations of whey and drying agents added to whey before drying (e.g. skim milk, sugar, in liquid or dry form, and cereal products), which yielded a satisfactory sheet of dry material when scraped from the drum dryer.
305. Jack, E.L., Wasson, A.J. J. Dairy Sci., 1941, 24, 85
THE RELATION OF CERTAIN FACTORS TO THE DRYING OF WHEY MIXTURES ON THE ATMOSPHERIC DRUM DRYER. Studies were made of some fundamental principles in the drying of whey by the atmospheric drum process, with particular reference to the properties of different combinations of whey and film-forming materials which yield a satisfactory sheet when scraped from the drums. A mixture of sweet whey and sweet skim milk in equal amounts was found to give a satisfactory dried product. As the titrable acidity of the whey increased, the amount of sweet skim milk required also increased. The effects of reducing the acidity of sour whey and of acidifying sweet whey, and the use of pre-condensed skim milk and whey, spray-dried skim milk, drum-dried skim milk and ground and sifted cereals are discussed.
306. Lavett, C. O. B.P. 522,054 (June 7th, 1940). Brit. chem. physiol. Abstr. B, 1940, p. 638
IMPROVEMENTS IN PROCESS FOR DRYING WHEY. After preliminary concentration to a total solid content of 30 to 50%, whey is passed to the angle between 2 heated rolls, so that it is carried upwards and then downwards and is then scraped off, having thus been further dried to a total solids content of e.g. 72 to 93%. By gravity the syrup passes to a second set of heated rolls for further drying, crystallization being induced by seed material provided by incomplete removal from these rolls. Continuous operation is described.
307. Lavett, C. O. B.P. 523,091 (July 4th, 1940). Brit. chem. physiol. Abstr. B, 1940, p. 761
IMPROVEMENTS IN APPARATUS FOR DRYING WHEY AND OTHER WASTE LIQUIDS. Divided out of B.P. 522,054. Drying (after concentration) is effected in 2 stages, each stage comprising a pair of heated drums arranged abreast. In the first stage the drums run away from the nip (which contains a pool of liquid) and from their lower arcs the material is scraped to drop into the nip of the second pair, which run towards each other.

308. Needles, D. D. B.P. 534,214 (March 3rd, 1941).
Manning, P. de V. Food Manuf., 1941, 16, 171 (Abstr.)
Brit. chem. physiol. Abstr., B.888, 1941,
p. 159

PROCESS FOR THE MANUFACTURE OF WHEY POWDER. Describes a process for producing a dry non-caking whey powder, in which moisture is removed from raw whey and the lactose allowed to crystallize. The greater part of the whey protein is coagulated by heat in presence of sufficient mineral acid to maintain the pH below 4.8 and then lactose is crystallized in presence of the coagulated protein.

309. Ramsdell, G. A. and Food Res., 1941, 6, 265
Webb, B. H.

UTILIZATION OF SKIM MILK AND WHEY IN PRE-COOKED DRIED SOUP.

Investigations indicated that skim milk and whey improved the body and flavour of spray-dried soup mixtures, when used in quantities up to 25% of the weight of dry mix. The process of roasting beans and peas at a temperature of 150°C for 45 minutes and grinding to a powder yielded products of greater water-absorbing capacity than those obtained by cooking and spray-drying the vegetables. Methods for producing soup of maximum viscosity with minimum solids were examined and formulae were developed for dried bean and dried pea soups. These dried soups with up to 8% of salt pork fat or butter fat developed no off-flavours during 9 months' storage at room-temperature (25° to 30C).

310. Schmitz, K.W.E., Haub, L.A.E. B.P. 524,37 (August 5th
and (Mrs.) W. Schmitz. 1940)

IMPROVEMENTS IN AND RELATING TO PROCESSES AND APPARATUS FOR DRYING MILK PRODUCTS. Whey or the like is thickened by evaporation of water and then converted into a solid by the single operation of mixing with air and cooling, the air being under pressure if necessary. It is claimed that the product is not hygroscopic and can therefore be stored for long periods.

311. Waite, R. J. Dairy Res., 1941, 12, 71

THE DRYING OF CHEESE WHEY AND OF ACID CASEIN WHEY BY THE ROLLER PROCESS. Investigations of the neutralization of cheese whey before drying by the roller process indicated that neutralization with calcium hydroxide gave a satisfactory product. The use of sodium or potassium compounds led to difficulties in drying and an unpalatable product of poor quality. Over-neutralization must be avoided. Similar investigations with hydrochloric acid casein whey indicated that reduction of acidity from 0.48 to 0.18% by addition of calcium hydroxide permitted of successful drying and gave a satisfactory product, which was, however, unpalatable. Acetic acid casein whey could be dried without previous neutralization and yielded an excellent and palatable product.

Chem. Phys. Bact.

312. ----- Food. Tr. Rev. Dec. 2, 1947
SUMMARY OF HANNAH DAIRY RES. INST. REPORT FOR 4 YEARS TO 31.3.47.
Effect on bacteriological quality by higher preheating temperature.
Anti-oxidants to retard rallowiness. Effect on milk powder of moisture content.
313. ----- Food Investigation Report
Report 1948, p. 10 D.S.I.R.
DRIED MILK. The rate of combination of the free amino groups of casein with glucose proceeds most quickly at moisture contents corresponding to R.H. 65-70%, but slower above and below this. Increases with p.H., from p.H. 3 to p.H. 9 and probably up to p.H. 10. Highest temperature coefficient of 5.4 between 15 and 25°C.
314. Coulter, S. T., Univ., Minnesota Food Technol., 1947, 1, 209-213)
NEWER KNOWLEDGE REGARDING THE MANUFACTURE OF POWDERED WHOLE MILK.
A review of the effect of various factors on condition and staling of whole milk powder. (15 references.) Factors include
Preheating Temperature
Quality of Milk
Clarification
Homogenisation
Drying operation (Spray) M should $\neq$ 2.5%
V.P. of Malt at 2.25% M is 1.0 m.m.
Moisture Levels above 2.5% are objectionable.
Gas Packing (include solid CO_2)
Anti-oxidants.
315. Crossley, E.L. and Johnson, W.A. J. Dairy Res., 1942, 13, 5
BACTERIOLOGICAL ASPECTS OF THE MANUFACTURE OF SPRAY-DRIED MILK AND WHEY POWDER, INCLUDING SOME OBSERVATIONS CONCERNING MOISTURE CONTENT AND SOLUBILITY. Describes a bacteriological study of commercial operation, over a period of 4½ years, of 2 Kestner evaporating and spray-drying plants, handling a fairly good and a very poor milk supply, respectively. Processes investigated comprised handling of raw milk, pasteurization, climbing film evaporation, handling of evaporated milk and spray-drying. Data were also obtained showing the influence of variations during processing on the moisture content and solubility of powders, separated milk, full-cream milk and whey being examined. The general bacterial flora of spray-dried powders and the influence of individual manufacturing processes, packing and storage were studied and possible control methods are suggested. Data showing the extent of both hourly and seasonal variations were also obtained. The flora of freshly-made spray-dried powders consisted essentially of certain Streptococci and Micrococci, representing

comparatively few species. Aerobic spore-forming bacilli and a few *Achromobacter* species occurred regularly, but only in small numbers, which were unlikely to be of practical importance. The plate count of powders was not directly related to the raw milk counts, but was probably affected by the numbers of thermophilic bacteria present in the raw milk and the storage conditions before processing. Plate counts at various stages during processing were correlated with one another and with the final powder count; wide variations between individual results were obtained. Pasteurization at a temperature of 163.3°C (331.7°F) for 30 seconds, followed by a 3 to 5 minute holding period, was sufficient to ensure destruction of pathogens and had no adverse effect on the solubility or nutritional value of the powder produced. Spray-drying destroyed many bacteria, but could not in itself be relied upon to destroy pathogens, since some non-thermoduric species survived. Precautions necessary for maintaining bacterial contamination at a minimum throughout the operations are discussed. A variable decline in numbers of bacteria occurred during storage, some species dying out more rapidly than others; spore-forming species survived longest, while coliform species disappeared rapidly, particularly coli I types. Both the plate count and coliform tests are only of limited value when applied to stored powders, especially when the conditions and duration of storage are unknown.

316. Henriksen, E. K. Ingeniøren, 1937, 46 (No. 3), 61, Chem. Zbl., 1938, 1, 1025 Chem. Abstr., 1939, 33, 7405

VITAMINS AND MILK (transl. title). Presents data on the occurrence, significance and manner of action of vitamins A to D in the human organism. Since vitamin D withstands sterilization temperatures, irradiated milk can be condensed. A considerable amount of vitamin C is destroyed by condensation, but vitamin B is relatively stable. The vitamin A content of winter milk can be regulated by proper choice of feed or by direct addition of vitamin A or carotene.

317. Henry, Kon, et. al. J. Dairy Res. 1948 15, 292-363
Chem. Abstr. 7454 42, 1948

DIFFERENTIATION ON STORAGE OF DRIED SKIM MILK OF VARIOUS MOISTURE CONTENTS., 3, 5, AND 7.0% SEE VERY LONG ABSTRACT IN "CHEMICAL ABSTRACTS".

THE RELATION OF THE USE OF CERTAIN ANTI-OXIDANTS AND METHODS OF PROCESSING TO THE KEEPING QUALITY OF POWDERED WHOLE MILK. Studies were made of the effects of (1) anti-oxidants, (2) temperature of pasteurization, (3) moisture content, (4) type of container and (5) storage temperature on the keeping quality of whole milk powder. Results indicated that it is possible to retard the development of oxidised flavour in whole milk powder by adding anti-oxidants to the milk before it is dried. The order of effectiveness of the anti-oxidants examined was (1) gum guaiac and hydroquinone (2) ascorbic acid and sodium citrate and (3) butyl ester of tyrosine, Avenex, Enzylac and a culture of *S.lactis*. Powder made from milk heated to a temperature of 170°F (77.2°C) for 30 minutes was less likely to develop oxidised flavour than that made from milk heated to higher (180°F (87.7°C)) or lower (150°F (65.5°C)) temperatures. High moisture content (5% or above) of the powder and high storage temperatures (30°C or above) increased the rate of development of oxidised flavour. Conditions which lead to brown discoloration of the powder during storage are described. The type of container influenced changes in colour, moisture content and flavour during storage. A reaction between the protein and other constituents of the milk is thought to be involved in the discoloration, reduction in solubility and fall in pH which occur concurrently. Solubility of milk powder could be increased by addition of sodium citrate to the milk before drying.

THE NUTRITIVE VALUE OF POWDERED WHOLE MILK. A study of Australian whole milk powder has shown that, while it could not replace fresh cow's milk, it compared favourably chemically and biologically with fresh whole milk.

STUDIES OF THE REACTION BETWEEN PROTEIN AND REDUCING SUGARS IN THE "DRY" STATE. I. The effect of activity of water, of pH, and of temperature, on the primary reaction between Casein and Glucose. Abstract in "Food Investigation 1948". D.S.I.R.

SURFACE TENSION OF MILK. H. has developed a novel torsion balance with two wires of different strength. It works on the surface Tension of liquids in motion and of colloids.

323. Prickett, P. S. Food Industr., 1943, 15 (No.8), 73
SEVEN WAYS TO BEAT BACTERIA IN A DRY MILK PLANT. Suggests the following ways of eliminating bacteria in a dry milk plant: (1) removing all or part of their water, (2) depriving them of food, (3) forcing unsuitable (high or low) temperatures on them, (4) making their environment either too acid or too alkaline, (5) destroying them before they can begin to multiply or grow, (6) treating them with germicidal chemicals or ultra-violet light and (7) daily use of steam and soap on the equipment. Methods of controlling bacterial growth in the separator, in netwells, in the vacuum pan and in the homogenizer, are dealt with.
324. Schwarz, G., Mumm. H. Dtsch.Molkereiztg, 1939, 60, 1008
 Chem. Abstr., 1940, 34, 2941
QUALITY CONTROL DATA IN THE PRODUCTION OF PRESERVED MILK IN THE YEARS 1936-38. IV. MILK POWDER (transl. title). Presents data pertaining to samples of drum-dried skim milk and whole milk powder. Variations in and average values of moisture, fat, hydrogen-ion concentration, degree of acidity and solubility are given.
324. Thompson, et. al. Ind.Eng.Chem. 25 1311-16 1933 19 Refs.
METALS AND CONDENSED MILK. Corrosion of metals in manufacture of evaporated and sweetened condensed milk.
325. Tyo, Z. Mitt.med.Akad.Kioto, 1939, 26, 1033 (in German). J.Dairy Sci., Abstr.Sect., 1941, 24, A141. Chem. Abstr., 1941, 35, 1883
THE ASCORBIC ACID CONTENTS OF VARIOUS MILK PRODUCTS, ESPECIALLY DRIED MILK (MILK POWDER) (transl. title). Gives average contents of total and reduced ascorbic acids and dehydroascorbic acid in samples of Japanese dried milks, prepared by the spray and roller processes from whole milk, milk containing added carbohydrates, skim milk, buttermilk and lactic acid milk. The percentage ratio of reduced to total ascorbic acids was higher in the whole milk powders than in the other preparations. Both reduced ascorbic acid and dehydroascorbic acid in raw milk undergo considerable destruction during the drying processes. The pH of mixtures of the dried milks and distilled water are given.

PECTIN

326. Bate-Smith, Gane, etc. B.I.O.S. Report No. 275 p.77
 Pectin is spray dried by Krause disc type sprayer. Details of mfr. of pectin (Water and acid extract of apple pomace).

327. Hinton, G. L. B.I.O.S. Report No.388 pp.3,7,14,22
TECHNICAL ASPECTS OF PECTIN MANUFACTURE. Pomace - Tray dryers -
 No details. Pectin - Spraydried. - No details, but a loss of 10%
 to 20% jellying power. Pectin Powder. - Krause spray dryer by
 Lurgi 20 gallons an hour, fairly old. No details. One firm adds
 1% tartaric acid.
328. Kertesz, Z. I. F.I.A.T. Report No.567
THE GERMAN PECTIN INDUSTRY. P.23. By precipitation with organic
 liquids. Is only used for pharmaceutical preparations.
 P.23. Beet pectin - Precipitation with Aluminium salts.
 P.24. Drying - Not on drums.
 - Enormous antiquated spray dryers. No details.
 Then extracted with alcohol to remove ash
 constituents.
329. Nelsen, R. C. U.S.P. 2,455,382.7.12.1948
PECTIN PRODUCT FROM CITRUS FRUIT PEEL. Sliced and washed peel
 in cooked in acidified water at 1.8 - 2.0 p.H. Extract separated,
 adjusted with sodium carbonate to p.H. 3.7-4.4, concentrated by
 vacuum, and spray dried at 300°F, and rapid cooling of dried product.

FRUIT

Process General

330. ---- Sulzer tech.Rev., 1943, No. 1, p.22
UTILIZING THE WASTE HEAT FROM A COKE COOLING PLANT FOR OPERATING A
 FRUIT DRYING PLANT. A note on the dehydration plant recently
 installed in the gas-works at Langenthal, Switzerland, for drying
 vegetables and fruit, the heat required for the drying process
 being obtained from the Sulzer coke-cooling plant. (From a report
 in the Monthly Bulletin of the Swiss Association of Gas and Water
 Engineers, Zurich, Vol. 21, No. 8.)
331. ---- Food Manuf., 1943, 18, 251
FRUIT DRYING EXPERIMENTS AT DITTON. Gives an account of work on
 the drying of English fruits, carried out by the Department of
 Scientific and Industrial Research at the Ditton Laboratory.
 There were found to be 2 types of plum from the point of view of
 drying: Clair plums, which when dried resemble the imported prune,
 and Victoria plums, which retain more of their normal colour when
 dried, and when reconstituted and cooked are indistinguishable from
 stewed fresh fruit. Greenches, daddons and Early Rivers plums
 also retain their colour and flavour when reconstituted. The fruit
 should be ripe when picked and graded before processing, speedways
 being removed and allowed to ripen to store at 50°F to 55°F (10.0
 to 13.3°C). Before drying, the fruit is dipped for about

10 seconds in a 1% caustic soda lye to remove the waxy coating of the skin, then rinsed in cold water and placed on wooden trays in a closed chamber, where air at a temperature of 70°C is passed over it. Natural colour and flavour of Victoria plums may be preserved by sulphuring before drying. Apples were dried successfully and had no brown tinge, provided the storage temperature did not exceed 10°C. Cherries and loganberries also gave good results. The possibilities of manufacturing fruit powders from windfall fruit, particularly apples and pears, are discussed.

332. Anon. Rep. Council, Sci. & Indust. Res. Australia, 14, 47, 1939-40, 15, 39, 1940-41

Includes a study of chemical and physical reactions involved in the drying process and information regarding the parts played in the drying process by oil, potash, wetting agents, etc. Imported olive oil has been replaced by suitably emulsified Australian cottonseed oil. The advantage is similar to that of potassium linoleate. The ash of sulfate and other prunings gives a potash solution sufficiently pure for dipping. Mould growth on racks appears possible by addition of 1% calciclanilide to the dip mixture. The importance of paraffin oil-casein-water emulsion as a wash for dried fruit has become more apparent. The possibility of using waste or low grade fruit for production of cream of tartar and alcohol is being investigated.

333. Atkinson, F.E., Strachan, C.C. Food in Canada, 1947, 3 (No. 6), 21
CANADIAN DEHYDRATION OF TREE FRUITS. Deals with developments in the dehydration of fruits, particularly in blanching, drying and packing. Improved methods of pre-treatment of apples, apricots, peaches, pears, cherries and prunes and sulphuring and stages in the process of dehydrating are described, with brief notes on the test for dryness, storage and curing, packing, and future prospects of the industry in Canada.

334. Braverman, J. B. S. Interscience Publ. Inc. N.Y. pp. 14 + 484, 1949, 54/-

CITRUS PRODUCTS. CHEMICAL COMPOSITION AND CHEMICAL TECHNOLOGY. The author is Director of Research of the Central Citrus Products Research Laboratory, Rehovoth, Israel. The scope is very wide. The final chapter deals with the application of modern methods to citrus problems, such as dehydration by sublimation and by infra-red heating and sterilisation of juices by ultra-violet radiation and by ultra-sonics.

335. Burger, I. J. Fmg S. Afr., 1943, 18, 478
DRYING OF FRUIT. A survey of improvements in methods of sun-drying and dehydration by means of artificial heat, with a table showing the pre-treatment required for certain South African fruits.

333. Castro, R. Bol.Frut.Hort.B.Aires, 1942, 7 (No.82-3rd Edition). Hort.Abstr., 1944, 14, 122 (Title only)

DESECACION DE FRUTAS. Deals with fruit drying in Argentina.

337. Cruess, W.V., La Moglia, J. Fruit Prod.J., 1942, 22, 13. Food Industr., 1942, 14 (No.10), 117 Canner, 1942, 95 (No.14), 13

FRUIT BAR FOR ARMY K RATION. Gives various formulae for making dried fruit bars. It is advisable to add honey, invert sugar syrup or glycerine to prevent hardness in dry atmospheres. Moisture content should be low to prevent hardness at low temperatures. Bars should be pasteurized after wrapping to reduce the risk of insect infestation.

338. Croce, F. M. Rev.Mens.B.a.P. 31 (362) 4, (363) 36 (366) 15, 1948

IRYING OF FRUIT (In Portuguese). General considerations concerned with drying of fruit and the elementary principles are outlined.

339. Fisher, C.D., Mrak, E.M. Fruit.Prod.J., 1942, 21, 175, 199 and 237 Long, J.D.

EFFECT OF TIME AND TEMPERATURE OF SULPHURING ON ABSORPTION AND RETENTION OF SULPHUR DIOXIDE BY FRUITS. A survey of farm sulphuring practices showed considerable variation of temperature in the same compartment as well as in the different compartments. Investigations are described in which apricots, peaches, pears, grapes and figs were sulphured, dried and stored in paraffined paper cylinders at room temperature after fumigation with ethyl formate. Results showed that sulphuring temperatures influenced the absorption and retention of sulphur dioxide after drying, the effect varying with the type, nature and pre-treatment of the fruit, gas environment values and drying conditions. The effect of sulphuring temperature on the quality of dried fruit is discussed. The use of high sulphuring temperatures (150°F (48.83°C)) improved the quality of Clingstone and Freestone peaches, Bartlett pears and Kadota figs. The effect of sulphuring temperature on the quality of sulphur-blanched raisins varied considerably with the condition of the skin of the berries at time of sulphuring. Sulphuring grapes at 125°F (47.38°C) was not so satisfactory as sulphuring at 70°F (21.11°C). Retention of colour in apricots varied with conditions such as variety or climate. Retention of colour in fruit sulphured at higher temperatures was due in part at least, to the greater retention of sulphur dioxide.

340. Mrak, E.M. Fisher, C.D. Fruit Prod.J., 1942, 21, 297
Bornstein, B.
THE EFFECT OF CERTAIN SUBSTANCES AND PRE-TREATMENTS ON THE RETENTION OF COLOUR AND SULPHUR DIOXIDE BY DRIED CUT FRUITS.
Investigations were made of the effects of dipping whole or halved apricots in solutions of varying concentrations of sodium citrate, sodium bicarbonate, sodium carbonate, tri-sodium phosphate, calcium hydroxide, sodium tartrate, citric acid and tartaric acid before sulphuring and drying, and of spraying the cut fruit before and after sulphuring, on the retention of colour and sulphur dioxide by the dried fruit during storage for 6 months. Fruit dipped in 5% sodium citrate solution before or after cutting and before sulphuring retained its colour longer than the other samples and apparently retention of sulphur dioxide was facilitated by this treatment. Spraying the fruit with sodium citrate or the other chemicals used before or after sulphuring did not facilitate the retention of either sulphur dioxide or colour. Fruit treated with citric acid, tartaric acid and sodium tartrate solutions retained slightly more sulphur dioxide than controls, but darkened rapidly in storage. Treatment with alkaline dips was not very satisfactory. When whole fruit was washed for 30 seconds in a 5% solution of sodium citrate, retention of colour in the dried product was good.
341. Furlong, C. R. Thorpes Dict. of Applied Chemistry 9
THE DRYING OF FRUIT.
342. Howard, L. S. F.I.A.T. Report No. 416
REMUEUR WERKE, H. F. JONES & CO. F.I. Three stage circular dryer, diagram, by Buttner. Direct coke fired; inlet gas at top shelf, passing downwards with the wet produce, which is moved mechanically along the lower 2 Troughs. (Rotating paddles). (Manufacturer considers this is obsolete and has changed to rotary dryer.) Inlet air 400°C. Exhaust 70°C. (Evidence of heat damage). Thence to a cyclone collector.
343. Hulme, A. C. F.I. Ditton Lab. Memo. No. 1/50.A. July 1950
THE DRYING OF ENGLISH PLUMS AND APPLES. Factors discussed:-
(1) Pre-drying treatment. (2) Use of a non-corrosive surface for supports during drying. (3) Temperature and time of drying.
(4) The moisture content of the dried fruit. D.S.I.R./4852/C.
344. Jenny, J. Schweiz. Zeit. Obst. u. Weinb. 52 492, 1943
Hort. Abstr., 14 50, 1944
USE OF SOLAR HEAT IN DRYING. A simple apparatus for sun-drying fruit has been designed at Wädenswil, Switzerland.

345. Jewell, W. R. J.Dep.Agric., Vict., 1943, 41, 85
DRYING AND PROCESSING TREE-FRUIT. Describes procedure recommended for drying and processing apricots, peaches, pears, nectarines, prunes and apples, with reference to methods of preparing the fruit, sulphuring and drying. Factors essential for the production of a high-grade pack and pest control by fumigation are discussed. Methods for determination of sulphur dioxide and moisture are given.
346. Kertesz, Z. I. F.I.A.T. Report No. 567 pp. 19-21
THE GERMAN PECTIN INDUSTRY. Description of drying oven and troughs in which the pectin is moved along by paddles to fall into the next trough. Inlet air 300°C. Exit air 80°C. Deals also with rotary and roto-louvre dryers.
347. Knight, A. J.Dep.Agric. Vict. 1941, 39, 21
FRUIT DRYING FOR HOME USE. Describes the preparation, sulphuring and drying of fruits such as apricots, apples, pears, peaches, prunes, grapes, cherries and figs.
348. Moubray, J. M. Rhod. agric. J., 1943, 40, 285. Hort. Abstr., 1944, 14, 50
DEHYDRATION. A brief note on the possibilities of dehydration for Rhodesian products. Since vegetables can be dried as cheaply overseas as in Rhodesia, it is considered more economical to concentrate on tomatoes, Cape gooseberries, citrus fruits, papaws, guavas, etc. The market for tomato powder is promising. The Government is assisting in the construction of a trial dehydration unit, using mainly local materials, to deal with 6 tons of ripe tomatoes in 24 hours. The dry product would be processed and packed for export at a central depot. The present method of packing is in 40 lb. waterproof paper bags, which are then wrapped in waterproof tobacco packing paper, baled in a baler used for tobacco and sewn up in export hessian.
349. Le Riche Farming Stn. Africa 22 5, 40, 1947
 C.A. 41 7008, 1947
THE NUTRITIVE VALUE OF CERTAIN DRIED FRUITS. A table is given of the amounts of chemical constituents, protein and carotene values of dried apple rings, peaches, pears, apricots and prunes.
350. Long, J.D., Mraz, E.M. California Agric. Exp. Sta. Bull. No. 622, Fisher, C.D. 1940. Exp. Sta. Rec., 1941, 31, 440
INVESTIGATIONS IN THE SULPHURING OF FRUIT FOR DRYING. (1) Factory sulphuring of fruit was found to require (1) absorption by the freshly cut fruit of enough sulphur dioxide to ensure retention of preservative in quantities sufficient to withstand losses in the fruit after losses which occur during normal drying and storage, (2) rapid drying in order to minimize loss of sulphur dioxide and (3) storage at temperatures and humidities sufficiently low to permit retention of sulphur dioxide. A survey and experimental work dealing with the first 2 of these problems are reported.

351. Mrak, E.M., Long, J.D.

California agric.Exp.Sta.Circ.No.380,
1941. Exp.Sta.Rec., 1942, 40, 880

METHODS AND EQUIPMENT FOR THE SUN-DRYING OF FRUITS. Deals with fruits used for drying, equipment (which is discussed in considerable detail), methods of preparation and drying, handling fruit after drying, farm-scale packing of dried fruits, storage and treatment of packed dried fruits and routine analyses.

352. Mrak, E.M. Pfaff, H.J.

Food Technology 1 No.2 147-160 Apr. 1947

RECENT ADVANCES IN THE PRODUCTION AND HANDLING OF DEHYDRATED FRUITS.

Until 1920, most fruit in California was sun-dried. Harvesting practices. Pre-treatment of various fruits, washing, sulphur dipping blanching, lye treatment, steam blanching, table of dipping periods and results. All fruits except persimmons are fumed with SO₂ or are dipped in a bisulphite bath. Tunnel Drying, 600-1000 ft.minute. Finishing temperatures 145-160°F according to required firmness. Yeast and mold survival. Drying Rates. Storage Deterioration. Large Bibliography.

353. Mrak, E.M., Pfaff, H.F.

Fisher, C.D. Mackinney, G. Food Industr., 1943, 15 (No.4), 59

DEHYDRATION OF FRUITS OFFERS IMPORTANT WAR-TIME ADVANTAGES.

Reviews current commercial practice for the dehydration of fruit in California as a basis for comparison of dehydration with other methods such as sun-drying and evaporation. Important advantages of dehydrated products are that (1) production is more rapid, (2) the moisture content is lower, (3) insect infestation is avoided and (4) nutritive value is higher. Standards, colour and methods of improving appearance and keeping quality of dehydrated fruits are discussed. Procedure recommended for dehydrating fruit is described, blanching and sulphuring requirements and temperatures and times for dehydration of cut fruits (apricots, peaches, pears, nectarines) being tabulated.

354. Perkins, M. S.

Fruit Prod.J., 1942, 22, 46 and 75

A BRIEF RESUME OF FRUIT DRYING AND PACKING. Outlines procedure for drying fruit in the sun or artificially in dehydrators. Insect infestation is the main cause of spoilage in dried fruit and precautions to be taken to avoid this source of loss are discussed. Containers for dried fruit and its nutritive value are dealt with briefly.

355. Perry, et. al.

Bull.Calif.Agric.Exp.St.Tech.Bull.18,
1946

PRINCIPLES OF AND EQUIPMENT FOR FRUIT DRYING.

356. Powers, Ray Trans-Am.Soc. H.V. Eng. 27 241 (1921)
DRYING OF FRUITS AND VEGETABLES.
 Data - air vel. (-)156 ft./min.
 Gives Temp., % rel. H., and % water in products at various times for several fruits:-
- | | | | |
|-------------------|------------------------------|------------------|-------------|
| Peaches | 83 to 15% water in 25.7 hrs. | 136 ⁰ | 26% R.H. |
| Pears | 78.8 13.6 " " " " | 136 | 26% " " |
| Beans (fresh) | 86 to 7.3 " " 19.5 hrs. | 133 | 30% R.H. |
| Pears | 75.6 to 12.1" " 22.5 hrs. | 140 | 33-86% R.H. |
| Beans (overgrown) | 57.8 to 6.8" " 17½ hrs. | 140 | 33-86% R.H. |

357. Siryl, G. A. Konserv.Plodo-ov.Prom., 1939, 10 (No.4), 22
 Chem.Abstr., 1942, 36, 5272
SELECTING APPLES AND PEARS FOR DRYING (Unpubl. title). Includes data showing the average chemical composition of apples and pears dried to a 20% moisture content, and the losses in sugars and acidity incurred in drying. The determinations were made with 3 varieties of apple and 2 of pear.

358. De Soriano, A. M. Hort.Abstr., 1944, 14, 120
 Rev.argent. Agron., 1943, 10, 385
INSPECCIÓN DE FRUTAS SECAS Y DESECALES DEL COMERCIO. Discusses results of examination of samples of dried fruits, including walnuts, figs, peaches, apricots, pears, prunes, apples and nectarines, in Argentina. Only 36% of the samples conformed to the commercial standard required by the U.S.A. Those packed in cellophane were in worse condition than those stored loose. It is considered that the standard could be improved. The trouble was largely due to insect infestation.

359. Stewart, J. Food Manuf., 1940, 15, 301
DRIED FRUIT - THEIR FOOD VALUE AND ECONOMICAL USE. Discusses briefly the drying, food value and use of raisins, sultanas, currants, figs and dates.

360. Tripp, E. H. Chapman & Hall, 1946
MORRIS' PRINCIPLES OF FRUIT PRESERVATION. Vol. VI, Jam making, canning and drying.

Granulated

361. Eddy, C. W. U.S.P. 2,496,278, 1950
DRYING FRUIT OR VEGETABLE MATERIALS CONTAINING ADDED METHYL CELLULOSE. Methyl cellulose of 15, to 4,000 centipoises is added in concentrations of 0.1% to 4.0% of the solids present in the juices to produce free flowing powders, flakes or granules, on drying.

362. Kitchener and Newsom U.S.P. 2,444,579 6.7.1948 Chem.Abstr.,
42,18,20,9.48 6961
TO PRODUCE A PRODUCT SIMILAR TO GRANULATED SUGAR FROM FRUIT.

Fruits_various

363. Anon. Agric.Gaz. N.S.W., 1942, 53, 90.
Hort.Abstr., 1942, 12, 170
DRYING APPLES. Describes methods used in Tasmania for the sulphuring and drying of sliced apple rings. Drying by kiln and tray evaporators and sun-drying are discussed briefly.
364. Denny, F. E. Contr.Boyce Thompson Inst., 1943, 13, 57
INACTIVATION OF THE BROWNING SYSTEM IN DRIED APPLES. White dried apple slices, obtained when fresh apple slices are dipped in a solution of thiourea and dried in a current of warm air, turn brown when soaked in water. Experiments showed, however, that when the thiourea-treated dried slices were heated at a temperature of 80°C for 1½ hours, this browning did not occur. Benzidine tests indicated that the organic peroxide and peroxidase constituents of the browning system were both present in the active condition in dried slices before heating and that the heat treatment destroyed only the peroxide component. When thiourea was added to fresh apple tissue before it was pulped and dried in a current of warm air, the resulting product in the form of films of dried apple pulp could be soaked in water without the resulting sauce becoming brown. The lowest amount of thiourea which would give this result was about 1 part to 10,000 parts of fresh apple fruit tissue (by weight). Benzidine tests showed that the organic peroxide component of the browning system was destroyed by thiourea and heating of the film of dried pulp at 80°C for 1½ hours resulted in inactivation of peroxidase.
365. Eidt, C. C. Canad.Dept.Agric.Publ.No.625, 1938
PRINCIPLES AND METHODS INVOLVED IN THE DEHYDRATION OF APPLES.
366. Mangan, J. L. New Zealand J. of Sci., & Techn. 30
No.2, 87-100 Aug. 1948
SULPHUR DIOXIDE AND STORAGE LIFE OF DEHYDRATED APPLES.
367. Sprenger, A. M. Schweiz. Z.Obst-u.Weinb., 1941, 50, 81.
Hort.Abstr. 1941, 11, 352
DIE TROCKNUNG VON APFELN. A note on apple drying investigations in Holland.

368. Schofield, E. E. Elect. West, 1939, 82, 113
ELECTRIC HEAT FOR DRYING APPLE SAUCE. Description of a process designed to convert cull apples into dried apple sauce. The process is still in the experimental stage.
369. Burrett, A. J. Dep. Agric. S. Aust., 1941, 44, 508.
 Hort. Abstr., 1941, 11, 351
DRIED FRUIT PACKING AND PROCESSING. Contains practical advice on the packing and processing of dried apricots and peaches so as to obtain maximum value. Small fruit is uneconomical.
370. Cruess, W. V. Fruit Prod. J., 1942, 21, 135
EXPERIMENTS ON DRYING UNSULPHURED APRICOTS AND PEACHES. The use of methods other than treatment with sulphur dioxide to prevent browning of apricots and peaches during drying was investigated. Halved apricots were dried in a small air-blast dehydrator at a temperature of 150°F (65.55°C) after (1) steaming on Monel screen trays for 5 minutes or (2) heating 40° Brix cane sugar syrup to 180°F (82.22°C) for 10 minutes and allowing to stand in the syrup for 3 hours. Results obtained were compared with those given by untreated and sulphured fruits. By steaming or heating in syrup, fruit of fairly good colour, exceptionally good cooking quality and good storage quality was produced. Mild treatments such as dipping in brine, pineapple juice or thio-urea solution had little effect in preventing darkening. Artificial dehydration was found to be more practicable than sun-drying.
371. Anon. Bull. Imp. Inst., Lond., 1941. 39, 25.
 Hort. Abstr., 1941, 11, 248
THE MANUFACTURE OF DRIED BANANA PRODUCTS. Describes procedure for manufacture of dried bananas (banana flaps) from ripe fruit and of banana chips and flour from unripe or three-quarter ripe fruit.
372. Dyer, E. J. B. P. 525, 820 (September, 5th, 1940).
 Brit. chem. physiol. Abstr. B, 1940, p. 822
IMPROVEMENTS IN OR RELATING TO THE PREPARATION OF DRIED FOOD-STUFFS FROM BANANAS. Ripe bananas are pulped and fed to a roller drier, designed to produce a sheet of the material dried to such a degree that it may be cut or stamped into flakes, biscuits, cakes, etc. It is claimed that the dried product can be stored indefinitely in air-tight containers.
373. Feigenbaum, J., Israelashvili, S. Food Res. 13 193, 1948
PREVENTION OF DARKENING OF BANANAS DURING DEHYDRATION. Soaking in 1 to 2 % thiourea solution for 5 to 6 minutes. Allyl thiourea was found to be ten times as effective as thiourea.

374. Mrak, E.M., Phaff, H.J. Fruit Prod.J., 1943, 22, 198
 Friar, H.
DEHYDRATION OF CHERRIES. Of the principal varieties of sweet cherry produced in California, the best variety for drying is considered to be the Bing, the poorest the Black Tartarian and others are good. Satisfactory dehydrated sweet cherries can be produced by clipping to check the skins, then drying at a temperature of 15°F (85.55°C). After dipping, and before drying, Royal Anne cherries should be sulphured for 15 to 30 minutes, but dark varieties should not be sulphured. Fruit may be pitted before drying, if desired, but pitting causes a considerable loss of juice.
375. Lee, F.N., Bergeret, G. Rev. Fac. Agron. Univ. Montevideo, 1942, No. 30, p. 97. Chem. Abstr., 1944, 38, 1576
DESHIDRATACIÓN DE FRUTAS CÍTRICAS PARA ELABORAR MERMELADA.
 Experiments on the dehydration of citrus fruits in a tunnel drier are described. The contents of water, total sugar, reducing sugar, protein, ether-extract on dry substance, mineral salts and acidity (as citric acid) in finished products made from oranges, grapefruit and lemons are given, as well as contents of sulphite and ascorbic acid, pH and index of inhibition. The preparation of marmalade from these products is described. It is concluded that satisfactory dried citrus fruits can be produced, which keep well, can be reconstituted readily and contain appreciable amounts of vitamin C and are perfectly suitable for making marmalade.
376. Cruess, W.V., Sugihara, J. Canner, 1941, 94 (No. 4), 11, Food Manuf., 1942, 17, 153
DRIED CITRUS FRUITS FOR MARMALADE. Investigations were made of the possibility of drying sliced citrus fruits for shipment to Britain for marmalade manufacture. Results showed that sliced citrus fruits could be dried readily and the dried fruits were satisfactory for making marmalade. Lightly sulphuring the fruit in fumes of burning sulphur gave practically perfect colour retention, the flavour was not adversely affected and vitamin C was well retained.
377. Boyer, S. A. Fruit Prod.J., 1942, 22, 45
NEW PROCESS FINDS WAY TO WIDER MARKET FOR CRANBERRIES. Describes a new dehydration process, in which cranberries are reduced to flake form. The berries are cooked in vats at a temperature about 180°F (82.22°C), the hot sauce is transferred to a hopper, where the air is replaced by an inert gas (to prevent loss of nutritive value by oxidation and enzyme action), and seeds and skins are removed in a pulper. The pulp is then drum-dried and chopped into flakes ready for cooking.

378. Rygg, G. L. Proc.Amer.Soc.Hort.Sci. 52 173, 1948
RELATIVE HUMIDITY FOR STORING DATES AT DIFFERENT TEMPERATURES.
 A linear relationship was found between the logarithm of the % moisture in dates and the % R.H. of the atmosphere in equilibrium at 24°C.
379. Natarajan, C.P., Chari, C.N. Fruit Prod.Jnl. 27 242, 1948
 Mrak, E.M.
YEAST POPULATION IN FIGS DURING DRYING. Comparison between sun-dried and dehydrated figs, by inoculating extracts, and related to drying times and conditions.
380. Shafik, M., Holmy, A.J. Bull.Soc.Fouad ler Ent., 1938, 22, 265.
 Rev.appl.Ent. A, 1939, 27, 506
A MUD BRICK OVEN FOR DRYING DATES AND CONTROLLING EPHESTIA.
 Describes experiments in which it is shown that the hot air oven described previously (see Vol. 12, No. 754) can be used for rapid ripening and drying of dates as well as for control of moths.
381. Blin, H. Rev.Hort.Paris (NS.) 31 368, 1948
THE DRIED FIG INDUSTRY IN ALGERIA. Suggestions are made for the modernisation of the industry.
382. Joubert, J. Fmg. S.Afr., 1939, 14, 375
FIG DRYING IN SOUTH AFRICA. Discusses suitable conditions for the successful production of dried figs in South Africa with reference to climate, altitude, irrigation, fertilizers, picking time, methods of spreading figs on trays, sulphuring and drying, processing by steam and suitable varieties. The Californian method of drying is described.
383. Skepper, A. H. Agric.Gazette N.S.W. 59 72, 1948
THE DRYING OF FIGS. White varieties are preferable for drying. Procedure is described for harvesting and sulphuring the fruit, drying it in the sun and packing it.
384. Mrak, E. M. Fruit Prod.J., 1943, 22, 170
DEHYDRATION OF GUAVAS. Describes dehydration experiments which were carried out in an air-blast drier with 6 varieties of guava. Tabulates results showing the drying characteristics and ascorbic acid contents of fresh fruit of the different varieties and the ascorbic acid, moisture and sulphur dioxide contents of dehydrated guavas. The procedure advised involves sulphuring and then drying at a temperature of 150°F (65.55°C). The dried product constituted well and may be used as a cooked fruit in desserts.

385. Le Riche, F.J.H., Western Province, Union of Sth. Africa, Dept. of
Fruit Res. Stn. Stellenbosch Agric. Fruit Res. Tech. Series
No. 14, 14pp. 1947
THE DEHYDRATION OF GUAVA VARIETIES IN SOUTH AFRICA. Clemine,
preparation blanching, tray drying in a cabinet, and the effects of
various factors on the vitamin C content.
386. Friar, H., Mrak, E. M. Fruit Prod. J., 1943, 22, 138
DEHYDRATION OF HUCKLEBERRIES. Presents results of drying tests
with the small Californian huckleberry. Berries about a day old
were washed in cold water and then dehydrated (1) without treatment,
(2) after steam-blanching, (3) after blanching and sulphuring and
(4) after sulphuring without blanching. Dehydration was carried
out in an air-blast drier at several temperatures. The dried
product was stored for 2 months at a temperature of 65° to 70° F
(18.33° to 21.11°C) and then examined for flavour and cooking
qualities. Tasting tests showed that untreated berries dried at
140°F (60°C) were preferred to the others but steam blanched berries
were acceptable. Dehydrated huckleberries are considered satis-
factory for use in pies and sauces can be prepared from them, but
they do not reconstitute well, so that in preparation of bakery
products it may be necessary to use a filler such as corn starch.
387. Smyser, A. A. Food Industr. 21 (9) 66, 1949
EIGHT FUTURE SEEN FOR HAWAIIAN MACADAMIA NUTS. The nuts after
removal of kernels are dried in an automatically controlled tray
drier in which the temperature rises from 43°C to 77°C; the moisture
content is then reduced to 1.5% in 8 hours, prior to roasting etc.
Output was only 100,000 lbs. in 1948.
388. Burgoyne, J.H., Thomas, A. J.S.C.I., 68, 300-305, 1949
MOISTURE RELATIONSHIPS OF PALM KERNELS, JUTE AND JUTE CONTAMINATED
WITH PALM KERNEL FAT. The most striking conclusion was that the
presence of palm kernel fat on the jute sacking increases the
moisture regain considerably at R.H. above 71%. Possible reasons
for this are discussed. (Union between fat and water or to
enhanced capillary condensation?).
389. Savastano, G. Bull. mens. Fed. int. Oleicult., 1937, 9, 211.
Hort. Abstr., 1939, 9, 288
LE SÉCHAGE DES OLIVES NOIRES DE FERRANDINA. Describes the develop-
ment of an efficient method for drying black olives in Ferrandina,
Italy. The method consists in immersing the olives for 1 to 5
minutes in boiling 10% brine, draining off the brine for several
hours and drying in a reversible plane drier at a temperature of
70° to 85°C. The drier is described and illustrated.

390. Cruess, W.V., Friar, H.F. Fruit.Prod.J., 1942, 22, 116
DEHYDRATION OF OLIVES. Discusses results of earlier experiments and of experiments made in 1942 on the dehydration of olives. Pitted dehydrated olives had a rich flavour and pleasing texture. Although low in other food constituents they were rich in oil. Tentative recommendations for preparation are made.
391. Anon. J.Dep.Agric.Vict., 1943, 41, 97
DRYING CLINGSTONE PEACHES. Describes procedure recommended by the Fruit Processing Committee for the commercial dehydration of clingstone peaches.
392. Ballantyne, J. A. Agric.Gazette N.S.Wales, 53, 89, 1942
 Hort.Abstr. 12 170, 1942
THE DRYING OF PEACHES. Describes procedure for drying peaches on trays. Mature fruit is pitted, sulphured, dried (preferably $\frac{2}{3}$) in the sun and the drying finished in stack. The maintenance of the sulphur dioxide content of the dried fruit within permitted limits is dealt with.
393. Mrak, E.M., Perry, R.L. Calif.Agric.Exp.Sta.Circular No. 841, 1945
 Hort.Abstr. 18, 230, 1948
DEHYDRATING FREESTONE PEACHES. Five alternative methods are described.
394. ——— Agric.Gaz.N.S.W., 1942, 53, 24
THE DRYING OF PEARS. The Williams or Bartlett is the only pear variety dried commercially. Fruit for drying should be eating ripe. Describes briefly procedure for sulphuring the fruit and drying it in the shade on wooden trays.
395. Croce, F. M. Rev.B.A.P., 1939, 22 (No. 255), 15.
 Hort.Abstr., 1940, 10, 96
DESECACIÓN DE LA PERA WILLIAMS. Gives details of the process of ripening and sun-drying Williams pears. Artificial drying, packing according to Argentine regulations, chemical composition and cooking of dried pears are dealt with also.
396. Jackson, T.H., Roger, B.E. E.Afric.Agric.Jnl. 16 (2) 84-5
 Dept. of Agric. Kenya. Oct. 1950
PEAR DRYING. Excess crop is cut, exposed for 24-48 hours to sulphur dioxide and dried in a pyrethrum dryer. Control experiments with unsulphured fruit showed the necessity and benefits of sulphuring.

397. Caldwell, J.S. et. al. Fruit Prod.Jnl. 27 311 & 346, 1948
THE UTILISATION OF SWEET PEPPERS. II. DEHYDRATION. Comparative values of 43 varieties for dehydration purposes are tabulated and the effects of drying on vitamin content are considered.
398. Cruess, W. V., Balog, E. Canner, 1943, 96 (No. 14), 11
DEHYDRATION OF PINEAPPLE. Reports that experiments made 25 years ago on the dehydration of pineapple were repeated and findings confirmed. The following procedure is suggested: (1) peel, core and slice ripe fruit, (2) spread 1 layer deep on flat-bottom wooden trays and place cars on dehydrator trucks, (3) put trucks in an air-tight sulphur house, where fruit is exposed to fumes of burning sulphur, (4) after 12 to 24 hours remove to the dehydrator, which may be either counter-current or 2-stage parallel + counter-current, and dry to a moisture content about 16 to 18% and (5) after sorting, pack at once completely in cartons, cans or boxes or, if fruit is to be packed later, store bins in an insect-proof room or sulphur fruit again before packing. Directions for cooking are given.
399. Cruess, W. V. Fruit Prod.J., 1943, 22, 324
PRUNE DEHYDRATION EXPERIMENTS. Describes the present practice for dehydration of prunes and deals with the effect of dipping on the rate of drying of French and Imperial varieties. Un-treated prunes of the French variety dried more slowly than those that were dipped or steamed and the steamed and lye-dipped prunes dried more rapidly than those dipped in hot water. Dipping appeared to have little effect on the rate of dehydration of the Imperial variety, although steaming shortened the drying time. Sulphuring for 30 minutes prevented moulding of prunes by brown rot fungus and did not affect colour, appearance or flavour of the dried product. The effect of relative humidity on the rate of drying of prunes is mentioned.
400. ---- Calif.Agric.Exp.Sta.Circular No.383,
 1948. Hort.Abstr., 18 232, 1948
DEHYDRATING PRUNES. A guide for the small scale processor.
401. Charl, C.N., Univ. of California Fruit Products Jnl. 27 206-
 211 1948 B.III. 42 18, 20/9/48
 Effects of Blanching and Dehydrating on enzyme activity and storage quality of high moisture unprocessed prunes.
402. Christie, A. W. Univ.Calif.Agric.Expt.Sta.Bull.404, 1936
THE DEHYDRATION OF PRUNES.

403. Perry, R. L. Trans. Amer. Soc. Mech. Engrs.
66 447-56 1944
THE DEHYDRATION OF PRUNES. Data are presented on heat and vapour transfer in the dehydration of prunes. Temperature measurements and moisture distribution within the fruit were observed. Mass transfer and heat transfer coefficients were calculated. The drying rate was proportional to moisture content except at low moisture content. The work constitutes a sound approach to the subject of fruit drying.
404. Ulrich, R. Lafond, J. C.R. Acad. Agric. Fr. 34 204 1948
DEHYDRATION AND REHYDRATION OF PRUNES IN ATMOSPHERES OF VARYING MOISTURE CONTENT. Equilibrium data at various temperatures are given.
405. Barany, N. Kiserlet, Kozl. (Reps. Hung. agric. Exp. Sta.) 1938, 41, 125. Chem. Abstr., 1939, 33, 7402
THE FLOUR OF DRIED BAKED PUMPKINS. (trans. title). Dried baked pumpkins were ground to (1) a fine flour, (2) a gritty flour, (3) pumpkin groats for human consumption, and (4) groats for animal feeding. The chemical composition of the products is given. Pumpkin flour can be detected in food by chemical and microscopic examination. Groats for animal feeding are a good carbohydrate-containing food.
406. Orton, E. C. J. Coun. sci. industr. Res. Aust., 1940, 13, 181.
VINE ASH IN DIPPING SULTANAS. Experiments showed that a properly prepared extract of vine ash is suitable for dipping sultanas and is almost as satisfactory in regard to quality and drying rate as a potash solution of the same density.
407. Culpepper, C. W. et al. Fruit. Prod. Jul. 28 45-53 1948
Abstr. BIII 88 Feb. 1949
DEHYDRATION OF TOMATOES. Concerns varieties and analysis.
408. Culpepper, C. W. Fruit Prod. Jul. 28 77-81 93, 1948
Caldwell, J. S. B. III 131 1949 March
Porte, W. S.
Hutchins, M. C.
DEHYDRATION OF TOMATOES. The results of the dehydration tests carried out on 24 varieties of tomatoes are summarised. Data for waste during peeling, trimming and drying are given. In general, sulphuring, prior to drying, gave better palatability, and aided retention of ascorbic acid and carotene.

409. Heese, W. J. Obst.u. Gemüse-Verwertungsind., 1942, 29, 38. Chem.Zbl., 1942, 1, 2469.
NEUE TROCKNUNGSVERFAHREN FÜR OBST UND GEMÜSE. Deals with new drying processes for the production of non-hygroscopic tomato powder and of savory and red cabbages in the form of whole leaves.
410. Christie, H. W. Food Inds.3.478-80.1931
DEHYDRATION COSTS OF WALNUTS.

VEGETABLES (AND FRUIT)

Equipment

411. Anon. Food Manuf.24 5-8 1949
VEGETABLE DEHYDRATION IN CORNWALL. Preparation and tunnel drying with parallel flow and recirculation.
412. Anon. Food, 1943,12,237
A NEW PLANT FOR DEHYDRATING VEGETABLES. Describes the design and operation of a new plant for denydration of potatoes, carrots and cabbage. The procedure for handling potatoes is dealt with in detail and modifications in the processing of cabbage are outlined briefly.
413. Arsdel van W. B. Food Industr.,1942,14 (No. 10), 43, (No. 11), 47 and (No. 12), 47.
TUNNEL DEHYDRATORS AND THEIR USE IN VEGETABLE DEHYDRATION. Deals with factors which govern the choice of a suitable denhydrator for vegetables, with reference to form of product, type of vegetable, size of drying plant, time and flexibility of operation, moisture content of product, prevention of objectionable odours, disposal of waste, etc. Describes general features of tunnel denhydrators and various types of air-circulation in them. The physical and engineering bases of the operation of continuous denhydrators of the tunnel type are discussed. The chief conclusions are that (1) while there are marked differences in the initial rates of drying of different vegetables, the times required to reach the same final dryness are more nearly alike, (2) the greater the surface exposed to the drying air, and the more porous the layer on the tray, the more rapid will be the rate of drying, (3) if air is circulated across the trays, the drying rate is highest at low densities of loading per square foot of tray area, (4) the drying rate increases as velocity of air flowing across the tray increases, (5) the higher the temperature and the greater the wet-bulb depression, the faster the drying rate will be, provided that case-hardening does not result, and (6) total drying time increases rapidly as final moisture content comes near to its equilibrium value. The

operating characteristics of tunnel dehydrators are discussed. The temperature change along a tunnel is dealt with and a diagram shows air temperature along counter-flow, parallel-flow and centre exhaust tunnels. The effects of (1) rate of tunnel loading, (2) specific differences between products, (3) increasing air flow through the tunnel, (4) increasing re-circulation of air, (5) variations in tray loading and (6) complications in practice are dealt with.

414. Birdseye, C. Food Technol, 1947, 1, 142-146
ENGINEERING ASPECTS OF DEHYDRATION IN THE ANHYDRATION PROCESS.
An apparatus suitable for dehydrating fruits and vegetables and entailing much less drying time than tunnel dryers is described. It consists essentially of five superimposed belts of stainless steel wire netting, each operating in a tunnel. Heated air enters at the "dry" end of the apparatus, travels upwards, and passes through each tunnel in the same direction as does the product, finally leaving the "wet" end. Stirring is accomplished by tedders located at frequent intervals over each of the belts, and winnowing and tossing of the product into the air stream is brought about by a suitable arrangement of fans.
415. Black, H. G. Canning Age, 1942, 23, 476
ADVANTAGES OF A CONTINUOUS CONVEYOR DEHYDRATER. Discusses the advantages of a continuous conveyor dehydrator, including minimum labour requirements, accuracy of control and small running costs. Costs of drying vegetables in one type of continuous conveyor dehydrator are tabulated.
416. Delamare, M. Gen. civ., 1943, 120, 42 (Abstr.).
CONSERVATION DES LÉGUMES ET DES FRUITS PAR LA DÉSHYDRATION, ENVISAGÉE COMME RÉGULATEUR ÉCONOMIQUE DU MARCHÉ. Summary of a paper presented at a meeting of the Association pour la Recherche des Economies et des Matieres de Remplacement at Orleans, on November 26th, 1942. Proposes the creation of mobile dehydration plants for use in smaller or more inaccessible centres of production, in order that products, which might otherwise be wasted, may be utilized.
417. Perry, Fea. R. L. CIO.S Rept. XXX-87
TH. LAMPE CONSERVEN FABRIK BRUNSWICH pp. 1-2. "Imperial Dryer" for Vegetables. Description - some data and diagrams.
418. Perry, Fea. R. L. C.I.O.S. Rept. 30-86 pp. 6 and 7.
VERSUCHSTATION FÜR KONSERVEN INDUSTRIE. Description of various types of dryer for vegetables. Products are usually prepared. Moisture is usually 10% but occasionally reaches 14%.

419. Goodall, C. B.P.624,348,7.7. and 26.11.47
APPARATUS FOR DRYING SPACER, SHEEDED VEGETABLES OR ROOTS, PEAT, AND THE LIKE. The plant consists of a horizontal heated plate on which the material is placed and over which a rolling and spreading mechanism travels (backwards and forwards). During the forward movement the material is pressed and during the backward movement it is pressed and then picked up and turned over by a rotating device which also advances the material to the discharge end of the plate.
420. Guillou, R. Agric. Engng, St. Joseph, Mich., 1942, 23, 313.
DEVELOPMENTS IN FRUIT DEHYDRATOR DESIGN. Reviews recent trends in design of fruit dehydrators. The general type consists of a counter-flow tunnel, into which the produce is fed on wooden trays loaded on small cars, heated air being blown through the tunnel in the opposite direction. Measurements were made of the rate of drying of prunes, in order to obtain quantitative relations between dehydrator conditions, rates of drying and quality of product. The steps involved in the drying process were (1) drying the material under various conditions, and deduction of empirical expressions for drying rate in terms of the variables involved, (2) separate development of the optimum value for each of the variables that is controllable and (3) embodiment in a design of the closest practical approach to these optimum values. The flow plan of a proposed 5-ton dehydrator is given.
421. Heinz, H. J. & Co. Food, 1942, 11, 223.
DEHYDRATED VEGETABLES. A SUCCESSFUL BRITISH PILOT PLANT. Describes the operation of the pilot vegetable dehydrating plant at the factory of H. J. Heinz & Co., Ltd. and methods used for preparing, drying, packing and testing the vegetables (mainly potatoes, cabbage and carrots).
422. Henley, A. T. Trans.Inst.Chem.Engrs. 6 pp. 102-114. Conf. 6.12.1928.
TUNNEL AND STOVE DRYING. Conditions and design for fruit drying.
423. Löschnig, J. Z. Eis-u. Kälteindustr., 1942, 35, 29 and 37. Chem. Zbl., 1942, 11, 1069.
ÜBER DIE KONSERVIERUNG DER GEMÜSE DURCH TROCKNEN. A short description of apparatus used in technical processes for drying vegetables.

424. Pyke, W. E., Barmington, R. Colorado Farm Bull. (Colorado agric. Exp.Sta.). 1942,4 (No.4), 10. Exp.Sta. Rec., 1943, 88, 849.

PRESERVING NUTRITIVE VALUE IN DRYING FOOD IS GOAL OF PROJECT: DEHYDRATOR PLAN GIVEN. Describes a tunnel drier, modified to fit into a portable cabinet and equipped with a gas heater of the radiation type. Cherries, potatoes, corn, beans, peppers, beets and carrots were successfully dehydrated in this apparatus. Analysis of carotene in the carrots showed that the dehydrated products contained nearly 10 times as much carotene per gm. as the fresh material.

425. Ridley, G. B. J.Ind.Eng.Chem. 12 45 1921
Includes an investigation of tunnel dryers.

426. Scott, A. W. Fuel and the Future 1 275 1948
Short description of a German Multiband dryer with an interstage heating for counter current flow, through-draught. 1.8 lb steam used for 1 lb water evaporated.

427. Sturgeon, R. A. B.P.501,129 (February 22nd, 1939).
IMPROVEMENTS IN DRYING APPARATUS. Vegetable crops in finely divided form or granular or fibrous materials are dried while carried in a stream of hot air in a vertical chamber, the lower sides of which diverge at an angle of 14° to give a decreasing gas velocity.

Process General

428. ----- Inst. of Fuel. Drying Study 21 March 1951.
PAPERS ON THE DRYING OF SOFT FRUITS AND VEGETABLES BY R. G. TONKING; AND ON THE DRYING OF VEGETABLES BY R. A. TEMPLETON.

429. ----- U.S. Dept. Agric. Misc. Publ. No. 540. 1944
VEGETABLE AND FRUIT DEHYDRATION

430. Ministry of Food Scientific and Tech. Series, H.M.S.O. 1946
Chapters 1-17.

VEGETABLE DEHYDRATION. An account of the development of the Ministry of Food full scale process for drying vegetables. The account is well provided with diagrams and illustrations of the various units. Chapter 5, 10 pages, deals with the dryer unit, a tray, tunnel dryer. Reasons for this choice, and a table of performance data are given. A survey of general technique and description of other types of plant are given.

As subsidiary to this work a "Handbook for Operators of Vegetable Drying Plants" (46 pp.) is issued by the Ministry of Food, 1944.

431. ----- Canad. Dept. Agric. 1943
DEHYDRATION OF FRUITS AND VEGETABLES.
432. ----- Sci. Libr. Bibl. Series No. 380 1930-37
 No. 587 1930-42
THE DRYING OF FRUITS AND VEGETABLES 115 and 188 References
 respectively.
433. ----- U.K. Progress Report Oct. 1943
 Dehydration. D.S.I.R. Ministry of Food
 VI part 7. pp. 1-13
FACTORY EXPERIMENTS ON THE PROCESSING OF VEGETABLES PRIOR TO
 DRYING.
434. ----- Elect. Times, Lond., 1942, 102, 620.
FRUIT AND VEGETABLE DRYING IN ELECTRIC POWER STATIONS. Describes
 a simple method of drying fruit and vegetables adopted in the
 Electricity Works at Aue (Baden, Switzerland). Baskets of
 fruits, etc. are placed close to the ventilating louvres of
 alternators, so that the hot air can pass through them. The
 fruit can even be suspended in small sacks against the louvres.
 The drying process takes from 1 to 9 days, pears and plums taking
 the longest time. Several tons of fruit and vegetables were
 treated in this way during the 1941 season, with satisfactory
 results.
435. ----- Wass.- u. Energiewirtschaft., 1941, 33
 (Nos. 3-4), 17
BETRIEBSERFAHRUNGEN MIT ELEKTRISCHEN DORRANLAGEN. Gives an
 account of experience in the drying of fruits and vegetables by
 means of electricity and discusses operation and costs of drying
 installations with and without artificial air circulation, and
 installations in which waste heat is recovered, with brief notes
 on construction and details of electrical driving equipment.
 [Taken from a report prepared by the Committee for Electric Heat-
 ing of Swiss S.E.V.]
436. ----- Bull. Ass. Suisse Elect., 1941, 32, 131.
EXPERIENCES D'EXPLOITATION FAITES AVEC DES INSTALLATIONS
 ELECTRIQUES DES SECHAGE. Review of experience in the use of
 electricity in drying fruits and vegetables. Gives a
 description of installations, details of drying arrangements,
 with tabular data on power consumption, temperatures and drying
 times.

437. Ministry of Food. Food Manufacture 10(8):71-8 1 Aug. 4.
BRITISH VEGETABLE DEHYDRATION. A summary of a complete account of the history of the development of wartime dehydration of vegetables and methods of quality control. It begins with the systematic research by D.S.I.R. commenced in 1938, and deals mainly with Potatoes, Cabbage and carrot, with a description of the 2 tunnel tray dryer process, 1st concurrent and 2nd counter-current with recirculation. Wet and dry bulb temperatures are given, and method of compression if required. Air speeds 300-800 feet per minute. Total time 6½ hours at 1-1½ lb. per sq. foot loading.
438. ---- Canner, 1943, 14, 96 (No. 22). Canning Age, 1943, 24, 398.
HOW TO DEHYDRATE VEGETABLES FOR THE USE OF THE ARMED FORCES. Deals with the preparation of vegetables for dehydration, types of dehydrater used, insulation against loss of heat and prevention of air-leakage in tunnel driers, vacuum tray driers, suitable packaging methods to prevent spoilage in dehydrated foods and the use of carbon dioxide in gas-packing dried vegetables in tins.
439. ---- Fruit.Prod.J., 1942, 21, 372.
THE COMMERCIAL DEHYDRATION OF FOOD IN WAR-TIME. A review, with special reference to the commercial dehydration of vegetables, soups, apples and other fruits and citrus juice concentrates.
440. Aitken, H. C. Food Industr., 1942, 14, (No.5), 41.
HOW CANADA DEHYDRATES FOODS. Gives an account of the dehydration of vegetables in Canada, using hot-end-loading, 1-way air-flow dehydrating tunnels. The vegetables are blanched before drying. When dried they are packed in tins in an inert atmosphere.
441. Allen Barker Mapson Tomkins J.S.C.I. 62 145, 1943
 63 78, 63 225, 1944
THE DRYING OF VEGETABLES PARTS 1, 2, AND 3.
442. Barker, J., Tomkins, R. G., U.K. Progress Report, Oct. 1940
 Wager, H. G. Dehydration, D.S.I.R. Ministry of Food, VI.1. pp. 1-19
SUMMARY ACCOUNT OF INVESTIGATIONS IN PROGRESS IN VEGETABLE DRYING. Results to date of experimental work on
 1. Laboratory and pilot equipment.
 2. Comparison of steam and water scalding.
 3. The drying of vegetables other than potatoes, cabbage and carrots.
 4. Scalding by hot air.
 5. Methods of assessing quality.
 6. The cooking of dried vegetables.
 7. The reabsorption of water by dried vegetables.
 8. References to previous work on which the present work is based.

443. Bate-Smith et al B.I.O.S. Report No. 275 p.50
 German practice is poor as compared to England or U.S.A. No advantages alternative to scalding. Carrots should not be scalded. Oxidization of Carrots is retarded by low moisture content. Potatoes are best scalded whole for 10-15 minutes then peeled, cut and dried. Not starchy this way.
444. Bruère, P. Gen.civ., 1943, 120, 42 (Abstr.).
LES LÉGUMES ET LES FRUITS DÉHYDRATÉS. Summary of a paper presented at a meeting of the Association pour la Recherche des Economies et des Matières de Remplacement at Orleans, on November 26th, 1942. Discusses conditions necessary for the successful denhydration of vegetables, so that the product contains only 10% water, and points out the advantages of denhydration. The preparation of denhydrated vegetables has been carried out in France since 1840, under the direction of the Service du Ravitaillement, in cooperation with the Conseil National de la Conserve.
445. Burton, L. V. Food Industr., 1941, 13 (No. 9), 53.
DEHYDRATION LOOKS UP; PILOT PLANT REVEALS NEW INFORMATION. Discusses problems concerned with the denhydration of vegetables, with special reference to the importance of enzyme control. A pilot plant at Sodies, N.Y., for the washing, blanching, denhydration and packaging of vegetables is described and illustrated. The dryers were designed by Dry-Pack Corporation and the process consists essentially of tray drying with automatic control of humidity, temperature and air movement.
446. Burton, L. V. Food Industr., 1942, 14 (No. 12), 40.
24 WAYS TO IMPROVE VEGETABLE DEHYDRATION. Stresses the necessity for (1) testing quality and palatability of denhydrated products, (2) cleanliness and hygiene in the plant, (3) efficient engineering operations in the plant and (4) proper use of control methods (e.g. thermometers, hygrometers, etc.).
447. Burton, L. V. Food Industr., 1943, 15 (No. 5), 51.
MULTI-STAGE DEHYDRATION PRODUCES BETTER FOOD AT LOWER COST. Gives a diagram showing the arrangement of a 4-stage operation, combining "pre-drier", centre-exhaust tunnel dehydrator and "finishing bin" drier, exemplifying multi-stage denhydration. This is a more economical method of drying to low moisture contents than single-stage denhydration and it is important in connexion with the discovery that each 1% reduction in moisture content of denhydrated vegetables below 5% can prolong the storage "life" by 50%. Summarizes criticisms of single-stage denhydration and discusses reasons for inefficient operation of dehydrators.

448. Burger, I. J. Eng S.Afr., 1943, 18, 475.
THE COMMERCIAL DEHYDRATION OF VEGETABLES. A brief survey of the general principles of dehydration of vegetables and a discussion of future prospects.
449. Beckley, V. A. and Notley, V. E. E.Afr.Agric.J., 1941, 7, 3.
DRYING OF VEGETABLES. Investigations were carried out to examine the possibility of drying different vegetables for supplying troops in the forward areas of East Africa. Preliminary tests were made on cowpea leaves and lucerne leaves for native troops, but they did not yield satisfactory results. Using a pyrethrum model drier experiments were made on the dehydration of potatoes, cabbage, cauliflower, French beans and carrots. Methods of preparing the vegetables, drying temperatures, and the effect of drying on appearance, palatability and ascorbic acid content are considered. The use of dried sweet pepper as an extra source of ascorbic acid for native troops is recommended. Methods of packing dried vegetables are discussed.
450. Carlin, G. T. et. al. B.I.O.S.Misc.Rept.No.19 Part 1
 253 pp.
SURVEY OF GERMAN WAR-TIME FOOD PRESERVATION p. 74-8 - "The Imperial 4-band Drier and the Schilde Cabinet Drier are by far the most important types used in Germany". Vegetables seldom dried below 10-14% moisture. Therefore quality is poor, especially as blanching was frequently omitted. Dried product compressed into blocks. Little detail.
 pp. 34-35-37-38-2. - Dehydration of various vegetables including Potatoes.
 Pt. 2. pp. 431-2. Instructions for the production of high quality dehydrating vegetables.
451. Chace, E. M., Noel, W. A. and U.S.A.Dept.Agric.Circ.No.619,
 Pease, V. A. 1941.Exp.Sta.Rec., 1942, 86, 155.
 Food Manuf., 1942, 17, 37.
PRESERVATION OF FRUITS AND VEGETABLES BY COMMERCIAL DEHYDRATION. Sufficient concentration of the soluble solids of fruits and vegetables inhibits the growth of moulds and bacteria, but enzymes capable of changing the composition, flavour and appearance are not always inactivated. Therefore fruits and vegetables to be dried must first be blanched or otherwise processed to inactivate such enzymes. Dehydration has the advantages of reducing bulk and weight (costs of storage and carriage being thus reduced) and that the cost of processing is lower than that of canning or freezing; dried products are also more convenient to use than fresh products. The merits of various types of drying equipment are discussed briefly and the engineering calculations for dehydration design are given. Details of preparation, pre-treatment and drying of numerous fruits and vegetables are tabulated. A list of patents is included. Supersedes U.S.A. Dep. Agric. Bull. No. 1335, 1925 (Exp. Sta. Rec., 1926, 54, 12).

452. Cruess, W. V. McGraw, Hill Book Co. 1938
COMMERCIAL FRUIT AND VEGETABLE PRODUCTS.
453. Cruess, W. V. Proc. Amer. Soc. hort. Sci., 1943, 42, 487.
INVESTIGATIONS IN VEGETABLE DEHYDRATION. Outlines investigations on dehydrated vegetables, dealing with raw materials, blanching experiments, drying temperature, types of dehydrator, dehydration and rehydrating ratios, vitamin losses and moisture content.
454. Cruess, W. V. West. Cann. Pack., 1942, 34 (No. 10), 39.
Exp. Sta. Rec., 1943, 88, 295.
VEGETABLE TESTS. A brief review of investigations at the University of California Fruit Products Laboratory on dehydrated vegetables, with recommendations to producers.
455. Cruess, W. V. Canning Age, 1943, 24, 94.
GOOD DEHYDRATING VEGETABLES FOR THE WEST COAST. Discusses the suitability of various vegetables for dehydrating purposes. Only vegetables in fresh, prime condition and of good quality should be used. The best varieties of carrot, potato, cabbage, onion, sweet potato and tomato for dehydration are dealt with.
456. Cruess, W. V., California Agric. Exp. Stn. Bull. 680.
MacKinney, G. 76 pp. 1943.
DEHYDRATION OF VEGETABLES. Complete instructions are given for the dehydration of a large variety of vegetables.
457. Krak, E. M. and Cruess, W. V. U. S. A. War Dep., C. M. Corps. Spec.
Subsist. Bull., 1941. Exp. Sta.
THE DEHYDRATION OF VEGETABLES. Contains essentially the same information as that given in a previous series of articles but includes additional illustrations and a tabular summary of procedures for preparing and dehydrating various vegetables.
458. Cruess, W. V. and Krak, E. M. Food Industr., 1943, 14 (No. 1),
57, (No. 2), 41, (No. 3), 48, (No. 4)
57 and (No. 5), 43.
WHAT'S KNOWN TO-DAY ABOUT DEHYDRATING VEGETABLES. A review of present knowledge concerning the dehydration of vegetables. Points out the advantages and disadvantages of dehydration and gives details of operations involved in preparation and blanching of vegetables to be dried. Describes different types of drying equipment, classified as air (natural- and forced- draft) driers and vacuum driers. The principles of dehydration are discussed with reference to heat and air requirements, re-circulation of air,

the effect of temperature on rate of drying, critical temperatures for drying and suitable relative humidities. Methods for prevention of case hardening of potatoes and peas and optimum moisture contents for various dried vegetables are included. Gives specific directions for the preparation and drying of asparagus, globe artichokes, green string or stringless beans, broccoli, beets, Brussels sprouts, cauliflower, cabbage, carrots, celery, chayote, corn, egg-plant, garlic, horse beans, kohlrabi, green lima beans, Jerusalem artichokes, kale, parsley, beet tops, chard and mustard greens, leeks, mushrooms, onions, okra, parsnips, peas, peppers and pimientos, white potatoes, sweet potatoes, pumpkin and yellow flesh squash, rhubarb, sauerkraut, spinach, summer squash and Zucchini (Italian squash), tomatoes, turnips and rutabagas and soup vegetables. A summary of procedures for the drying of these and other vegetables is tabulated. Approximate yields of dried vegetables are noted. Describes procedure for storing dried vegetables, with special reference to insect infestation and its control by fumigation, cold storage, non-bacterial decomposition and moulding. Methods of packing in cartons, cans, glass containers or compressing into bricks and "sausages", methods of using dehydrated vegetables (refreshing and cooking) and methods of examination are considered.

459. Cruess, W. V. and Mrak, E. M. Fruit Prod. J., 1940, 20, 100.
THE DEHYDRATION OF VEGETABLES. Summarizes procedures recommended for drying various vegetables, and deals with selection of raw products, washing and preparation for blanching, slicing, trays used, dehydrators, drying temperatures, final moisture content, refreshing, cooking and preparation of soup mixtures and flours. Dried vegetables should be kept in a room that can be fumigated until they are packed in insect-proof containers and should be stored at or below a temperature of 32°F (0°C) to prevent insect infestation. Tin cans are the safest containers.
460. Cruess, W. V. and Mrak, E. M. California agric. Exp. Sta. (Mimeographed Report), 1941. Canning Age, 1941, 22, 524. Fruit Prod. J., 1942, 21, 201, 241, 269, 302, 327.
THE DEHYDRATION OF VEGETABLES. The chief operations involved in the preparation of vegetables for drying and types of dehydrators used are described. The principles of dehydration are discussed. Directions are given for drying asparagus, globe artichokes, green string or stringless beans, broccoli, beets, Brussels sprouts, cauliflower, cabbage, carrots, celery, chayote, corn, egg-plant, garlic, horse beans, Jerusalem artichokes, kale, parsley, beet tops, chard and mustard greens, kohlrabi, green lima beans, leeks,

onions, mushrooms, parsnips, peas, pepper and plantains, potatoes, sweet potatoes, pumpkin and yellow flesh squash, rhubarb, cauliflower, Italian squash, tomatoes, turnips and rutabagas and soup vegetables. Theory of dried vegetables, with reference to protection against insect infestation and mould, methods of packing in cartons, cans and glass containers, and compression into "orients" and "cans-ets," and the use and examination of dried vegetables are dealt with.

461. Cruess, W. V. Fruit Prod.J., 1942, 21, 368.
NOTES ON THE DEHYDRATION OF VEGETABLES - PART AND PRESENT.
A review of developments in the dehydration of vegetables for use in the armed forces.
462. Cruess, W. V. Industr.Engng Chem., 1943, 35, 53.
Canning Age, 1942, 23, 574. Canner, 1942, 95 (No. 16), 12.
DEHYDRATION OF FRUITS AND VEGETABLES. Describes the mechanical preparation (peeling and sub-division) of vegetables for drying, the chemical treatment (sulphuring, blanching, fermentation, brine-dipping and pickling) before drying, various methods of tunnel drying and other methods of dehydration (vacuum dehydration, oil pickling, drum drying and spray drying). Deals with inspection, packaging and storage, control analyses and rehydration and use of dehydrated vegetables.
463. Crosbie-Walsh, T. Food Manuf., 1942, 17, 30.
VEGETABLE DEHYDRATION FOR HUMAN FOOD. Gives an illustrated description of a factory of the Farmers' Marketing and Supply Coy., Ltd., for the dehydration of potatoes, carrots, onions, parsnips, turnips, swedes, beetroot, parsley, mint and other vegetables in powder, flake or kibbled form. The dehydration of potatoes is described in detail. Drying is carried out by means of a tunnel drier, but processes of drying by steam-heated cylinders, rotary drums and a fluid bed method (not shown) are also used in the Company's other factories. A new potato powder, which, it is claimed, can be reconstitution into satisfactory mashed potatoes, is referred to.
464. Crosbie-Walsh, T. Food Manuf., 1942, 17, 217.
THE BIRTH OF VEGETABLE DEHYDRATION. Describes methods of preparation, types of drying equipment and packaging of dried potatoes, carrots and carrots, as carried out in a pilot plant set up in a factory by the Ministry of Food. Instructions for cooking the products are noted. The recent testing of samples of dried meat and dehydrated butter fat is mentioned.

465. Crosbie-Walsh, T. Food Manuf., 1943, 18, 289.
DEHYDRATION FACTORY NO. 1. Description and illustrated procedure used in a new vegetable dehydration factory, inaugurated under the auspices of the British Ministry of Food. Potatoes are peeled, washed and cut into strips, the strips are washed, blanched, tunnel-dried, packed in 4-gallon tins and the air in the tins is replaced by nitrogen. The tins are then sealed and tested for leaks, after which the seams are painted with bituminous lacquer. The method used for cabbage and carrots is also outlined.
466. Diemair, W., Lotzbeyer, E. Z. Lebensmittel-Untersuch. u. Forsch. 88, 594, 1948.
THE CHEMISTRY AND TECHNOLOGY OF DRIED VEGETABLES.
467. Dykstra, P. H. Rhode Island agric. Exp. Sta. Misc. Publ. No. 16, 1943. Exp. Sta. Rec., 1943, 89, 396.
THE DEHYDRATION OF RHODE ISLAND FRUITS AND VEGETABLES. This brief report based on preliminary trials using the type of drier and methods described in U.S.A. Dep. Agric. Emrs' Bull. No. 1918 presents general instructions for the drying, storage and cooking of dehydrated fruits and vegetables and tabulates specific directions for beets, beet greens, spinach, soy-beans, cabbage, Corn, peppers, apples, cranberries, peaches and pears. Recent developments in home dehydration are referred to.
468. Davis, M. B., Eldt, C. C. Proc. Inst. Food Tech., 1942, 3, 90. Chem. Abstr., 1943, 37, 960.
 MacArthur, M. and Strachan, C. C. 1943, 37, 960.
FACTORS AFFECTING THE QUALITY OF DEHYDRATED VEGETABLES. Give an account of investigations of the effect on quality of dehydrated vegetables of (1) pre-processing treatments included under the term "blanching", (2) operation of the dehydrator and its adaptation to varied products and (3) proper packaging and storage of material to ensure the longest possible storage life. An appendix contains a description of the cooking methods which have been adopted for preparing dehydrated turnip, carrot and cabbage in large quantities.
469. Dunn, C. G. Food Technol. 1947, 1, 133-141.
 Highlands, M. E.
ARMY CONTRIBUTIONS TO VEGETABLE DEHYDRATION DURING WORLD WAR II. General survey of U. S. Army contributions to vegetable fruit and vegetable dehydration necessitated by World War II. This is mainly economic and gives no practical detail.

470. Edlt. C. C. and MacArthur, M. Food in Canada, 1942, 2 (No. 3), 25. Food Manuf., 1943, 18, 223.

PRINCIPLES OF DEHYDRATING VEGETABLES. Gives an account of work at the Central Experimental Farm, Ottawa, Ontario, on the dehydration of vegetables. Deals with the blanching procedure, methods of treating cabbage and other vegetables with sulphite and preliminary work on the use of sulphiting to delay discoloration of dehydrated potatoes during storage. Give details of methods used in Canada for processing potatoes, carrots, turnips, cabbage, onions and beets. Conditions of blanching and dehydration required for different vegetables are tabulated.

471. Edlt. C. C. Canad. Food Packer, 1942, 13 (No. 4), 17. Hort. Abstr., 1942, 12, 169.

REVIEW OF DEHYDRATION IN CANADA. Deals with the development of methods for the dehydration of foods, as a result of work in Canada and abroad. Commercial plants in Kenoville, Noyl, Ontario, on a laboratory scale were potatoes, carrots, turnips and cabbage. High percentages of vitamins A, B and C were retained and palatability, appearance and appearance of the rehydrated product equalled that of freshly cooked vegetables. 5 Commercial plants are to operate in Canada. Reductions in weight obtained were 8 : 1 for potato, 11 : 1 for carrot and turnip and 17 : 1 for cabbage. Under average conditions the product should store well for 2 years and withstand poor conditions for an appreciable time. 10 Fruit dehydrators are now operating in Canada. Investigations on fruit and vegetable drying are being continued.

472. Edlt. C. C., MacArthur, M. Food in Canada, 1942, 2 (No. 11) 22. Davis, M. E.

DEHYDRATION OF FRUITS AND VEGETABLES IN CANADA. Discusses preparation and processing of fruits and vegetables, with reference to improvements in methods and in quality, the necessity for optimum quality and condition of raw materials, the importance of pre-processing treatments, the importance of storage and care for storage and preparation of fruits and vegetables for dehydration.

473. Edlt. C. C. and MacArthur, M. Food in Canada, 1942, 2 (No. 11) 22. Davis, M. E. DEHYDRATED BEANS. In order to develop a suitable procedure for production of dehydrated beans, a study was made of the factors which affect the dehydration process, such as factors such as drying time, bean varieties and bean condition. The process of drying and dehydration was studied in detail. The beans were dried in a forced circulation hot air tunnel dehydrator at a temperature of 120°C. The most suitable variety was found to be the pea bean. Preparation and packaging methods are also given.

474. Fachmann, W. Vorratspflege u. Lebensmittelforsch., 1940, 3, 522. Chem. Zbl., 1941, 1, 2335.
VERFAHREN ZUR TROCKNUNG VON OBST UND GEMÜSE UND DEREN ERZEUGNISSEN, IHRE VOR- UND NACHTEILE. Describes the various technical methods used for denaturation of fruits and vegetables and their products and discusses the advantages and disadvantages of the different systems. Requirements for dried products are (1) specified external appearance (i.e. colour and odour), (2) good swelling ability, (3) retention of the nutritive value, aromatic substances, vitamins, etc. of the raw material and (4) maintenance of flavour. Procedures for pre-treatment (i.e. blanching) of vegetables and storage of the dried products are also dealt with briefly.
475. Fachmann, W. Obst-u. Gemüse-Verwertungsind., 1940, 27, 467. Chem. Zbl., 1941, 1, 3306 (Title only).
 See Vol. 16, No. 767.
EINSATZ VERSCHIEDENER VERFAHREN UND SYSTEME ZUR TROCKNUNG VON OBST UND GEMÜSE UND DEREN ERZEUGNISSEN.
476. Faure, A. Bull. Soc. Ing. civ. Fr., 1941, p. 151. Chem. Vol., 1942, 11, 1825. Bull. int. Ind. Refrig., 1942, 23, 41.
DEHYDRATION OF FOOD PRODUCTS. (transl. title). Discusses artificial drum-drying, hot air vacuum-drying and spray-drying, with special reference to the drying of fruits and vegetables.
477. Gane, R. J. Sci. Food. Agric. 1 42-46 1950.
WATER RELATIONS OF SOME DRIED FRUITS, VEGETABLES AND PLANT PRODUCTS. Moisture content at a given R.H. depends upon content of non-diffusible colloids and water soluble substances present. Data are additive for mixed products, e.g. soup powders.
478. Havighorst, C. R. Food Industr., 1943, 15 (No. 12), 82.
NEW DEHYDRATION PLANT HANDLES RECORD QUANTITIES. Describes and illustrates methods of preparation and blanching, dehydration and packaging procedure in the new Special Food Corp. plant at Salinas, California for denhydrating carrots. A feature of the plant is the "merry-go-round" conveyor on which the carrots are trimmed.
479. Heinzelmann, T. Bull. schweiz. elektrotech. Ver., 1940, 31, 331.
TROCKNEN VON OBST UND GEMÜSE MITTELST ELEKTRICITÄT. Describes drying of fruits and vegetables in the home and in small-scale plants by means of electricity. Describes briefly apparatus used, i.e. ovens of electric cookers, household drying equipment with a capacity of 5 to 10 kg. of the fresh product, small-scale driers with a capacity of 30 to 120 kg. and large central drying installations for use in production areas. Amounts of electrical energy required in the different types of apparatus for drying products such as apples, pears, cherries, apricots, beans, peas, tomatoes, spinach and soup vegetables are tabulated.

480. Heiss, R.

Angew. Chem. 1948 20(13)69-71 B.III.
Nov. 1948.

DEHYDRATION OF VEGETABLES. Sound materials necessary. Hot
air or steam for minimum time for individual purposes. Required
temperature is 75°C for potatoes and 40-65°C for other vegetables.
To avoid loss of vitamin C. use dry air and comminute the
material.
For storage, moisture is usually 5-10%. Storage in Nitrogen
reduces carotene loss in carrots.

481. Heller, G. E.

Canning Age, 1943, 24, 294 and 356.

CONTROL INSTRUMENT APPLICATION TO DEHYDRATORS. RECOMMENDED
INSTALLATION FOR BATCH AND CONTINUOUS DRYING. Deals with the
problems met in selecting satisfactory automatic controls for
temperature and humidity in the dehydration of vegetables. Gives
a diagram of a typical batch or compartment drier, with manually
adjusted dampers for controlling air flow and exhaust and fresh
air dampers for controlling humidity. Dry-and-wet-bulb tempera-
tures should be controlled so that maximum drying rate is obtained
without excessive surface drying. The temperature should not be
too high when the product is not being cooled by a large evapora-
tion of water. Similarly, automatic controls for tunnel
dehydrators are discussed; the same principles govern selection.
The conditions existing in a 2-section tunnel dehydrator are
shown diagrammatically; in the first section there is parallel
flow and in the second section counter flow of product and air,
with suitable indicating controllers of relative humidity.

482. Hohn, E.

Schweiz. Z. Obst-u. Weinb., 1939, 48, 371
Hort. Abstr., 1940, 10, 182.

DAS DORREN VON OBST UND GEMUSE. Results are given of
experiments in Switzerland involving technical tests of the
different types of apparatus used for drying pears, apples and
beans, and comparative studies of the dried products of different
varieties.

483. Janny, J.

Schweiz, Z. Obst.- u. Weinb., 1943, 52,
517. Hort. Abstr. 1944, 14, 50.

NEUER UND VERBESSERTE DEHYDRATOR MIT KONDENSATION DES
WASSERS UND LUFTWÄSSERUNG. Describes a new model of a
medium-sized dehydrator designed at Wädenswil, Switzerland.

484. Jones, A. H.

Food in Canada, 1943, 3(No. 7), 16.

MICROBIOLOGICAL STUDIES ON DEHYDRATED VEGETABLES AND FRUITS.
From examination of samples of dehydrated vegetables and fruits
produced commercially, and from observations made on visiting
plants to study conditions under which the products were
prepared, data have been obtained on the microbial contamination
of dehydrated vegetables and fruits in Canada, as well as on

factors concerned with plant hygiene and faulty practices in handling the products. Types of spoilage are discussed. The range of bacterial counts in commercially dehydrated vegetables and fruits, as well as numbers of micro-organisms in products dehydrated experimentally, and the range of bacterial counts in dehydrated vegetables in 1 plant over a period of five years, were determined. The effect of blanching on coliform bacteria, the influence of storage on microbial content and growth of bacteria in rehydrated products were investigated. Observations in the plants indicated the need for close supervision of the moisture content of the finished product, of prompt processing, of plant tests for determining the microbial content and for establishment of microbiological standards for dehydrated vegetables.

485. Arengo-Jones, R. Canad. Food Packer, 1942, 13 (No. 8), 13.
Food, 1942, 11, 292 (Abstr.).

VEGETABLE DEHYDRATION IN CANADA. Discusses recent developments in processes for the dehydration of potatoes, carrots, turnips and cabbages. Sulphuring and blanching processes are described. The drying plant comprised 2 tunnels, in one of which the air-flow is counter-current and in the other parallel-current. To prevent oxidation, it was found necessary to pack cabbage in an atmosphere of carbon dioxide and turnips and carrots in nitrogen.

486. Khan, K. M. A. Indian Eng. 1941, 2, 461. Hort. Abstr.,
1942, 12, 116.

DRYING OF FRUITS AND VEGETABLES. Indicates the favourable conditions in India for drying fruit and describes procedure for the sun-drying of peaches, plums and pears by small-holders. Choice of fruit for drying, suitable cultural practices, maturity and harvesting in production of fruit, preparation of fruit and equipment required for drying, curing or sweating and packing of dried fruit are discussed.

487. Knauth, A. Braunsch. Konserven-Ztg., 1938, No. 20,
p. 3. Chem. Zbl., 1938, 11, 1505.

DER TROCKNUNGSVORGANG BEIM TROCKNEN VON OBST UND GEMÜSE.

A description of drying processes for fruit and vegetables and the erection of drying plants.

488. Kintner, J. S. and Vet. Bull. U. S. Army, 1943, 37, 12. Food
Delay, P. D. Industr., 1943, 15 (No. 4), 120 (Abstr.).

CAUSE OF SPOILAGE IN A PLANT PREPARING DEHYDRATED CABBAGE FOR ARMY USE. Indicated the danger of high bacterial counts in the product when inadequate or make-shift equipment and buildings are used. Unhygienic conditions in the plant resulted in a product containing active

493. Mrak, E. M. Fruit Prod.J., 1941, 20, 267.
SOME FACTORS IN THE PRODUCTION OF DRIED FRUITS. Outlines various procedures used in the drying of fruits. Construction and operation of several types of dehydrators and evaporators are described and illustrated. The advantages of dehydration over sun-drying are considered. Types of deterioration which may occur in sun-dried fruit are listed.
494. Rottinger, A. C. B.P.508,751(July 5th, 1939).
IMPROVED MANUFACTURE OF DRIED VEGETABLE PRODUCTS. Before drying on roller driers, fresh vegetables are ground and mixed or kneaded into a paste or dough with egg yolk or milk or soya, the dried preparation being ground as required. Cereal flours may also be included. Examples are given of the preparation of spinach powder and vegetable flakes.
495. Serdik, Inc. B.P.503,547(April 11th, 1939).
APPARATUS FOR REMOVING THE MOISTURE CONTENT OF MATERIALS, FRUIT AND VEGETABLE FILMS. Describes a process for removing moisture from fruit pulp, etc., in which the material is spread on a drying surface, such as a heated rotating drum, and the dried film is removed and conveyed rapidly under tension by rollers in an air-conditioned chamber, where the opposite sides of the film are subjected to currents of conditioned cooling air.
496. Schmidli, G. Bull.Ass. Suisse Elect., 1942, 33, 369.
DÖRRAUSSTELLUNGSGERÄTE FÜR ELEKTRISCHEN STROM IN BADEN. Gives an account of the fruit and vegetable drying plant at the Municipal Electricity Works, Baden, Switzerland, with an illustrated description of driers attached to the generators of the power plant.
497. Schieferdecker, H., Editor Serger and Hempel, Brunswick
 2nd Edition 1942.
DAS TRENNEN VON GEMÜSE UND OBST, SOWIE DIE HERSTELLUNG VON FRUCHT- UND GEMÜSEPRODUKTEN. A practical dealing with various aspects of the drying of vegetables, i.e. (1) the development of vegetable and fruit drying in Germany (H. Schieferdecker), (2) the importance of dried vegetables in times of war and peace (H. Mosolff), (3) practical vegetable drying (W. J. Heese, H. Schieferdecker and H. Suthoff), with descriptions of types of equipment and processes involved and the drying of particular products and fungi, also storage, pressing and packing, (4) improvement and estimation of quality (R. Heiss), (5) fruit drying (W. J. Heese and H. Schieferdecker), including processes for individual fruits, (6) the drying of fruit residues (W. J. Heese), (7) the drying of fruit pulp, pulped vegetables

and fruit juices (W. Koeniger), (9) insect damage to dried fruit and vegetable products (Zacher), (10) the preparation of dried vegetables and dried fruits in the home and in community centres (H. ...), (11) the drying of berries (K. Fappert), (12) preparation of dried potatoes for food (W. Kröner) and (13) legal standards (W. Fachmann).

498. Schneebeil, J. Bull. Ass. Suisse Elect., 1942, 33, 347.
VERANLASSUNG IM LIMMATWERK WETTINGEN. Gives an account of a fruit and vegetable drying installation, showing how a very efficient large-scale drying plant was developed by utilization of waste heat of the alternator at Limmat power station, Wettingen, Switzerland.
499. Singh, L. and Lal, G. Indian Fmg, 1941, 2, 308. Hort. Abstr. 1941, 11, 353.
DRYING OF VEGETABLES. An account is given of the general principles involved in drying vegetables, with details of procedure for drying potatoes and outlines of methods of drying onions, cauliflower, carrots and peas. Describes some experimental results obtained in investigations under the Fruit and Vegetable Preservation Scheme of the Punjab Government and Imperial Council of Agricultural Research.
500. Sherman, - Standard B.P. 606, 882.
Telephones and Cables
VACUUM DRYING OF VEGETABLES. Vegetable drying in vacuo is claimed to give a higher degree of desiccation than is otherwise obtained.
501. Tasker, C. Heat. Vent. Engr. J. Air-Cond., 1943, 16, 392. Proc. N. Z. Ass. Refrig., Inc., 1943, 11, 41 (Extracts).
THE VEGETABLE DEHYDRATION INDUSTRY IN NORTH AMERICA. Gives an account of the vegetable dehydration industry in North America, in pre-treatment of vegetables and fruits to be dried, drying equipment available, general features of tunnel driers, arrangements for air-circulation, moisture content of dried vegetables, the effect of dehydration on nutritive value, rates of drying of vegetables, changes in temperature along a tunnel, packaging of dehydrated foods and American views on the future of the dehydration industry.

502. Tobin, R. B. Proc.Inst.Food Tech., 1943, p.58.
Canning Age, 1943, 24, 410.
PLANT PROBLEMS IN THE DEHYDRATION OF VEGETABLES. The procurement selection and storage of raw materials are discussed. Types of peeler are described with special reference to those used for potatoes. Blanching is dealt with briefly, and some cost figures are given.

503. Tomkins, R. G. Paper at Inst.of Fuel Drying Study
1950 D.S.I.R. Records 7/6/2.
THE DRYING OF SOFT FRUITS AND VEGETABLES. An account of the general principles of drying fruit and vegetables. The essential process features for ensuring good quality and storage are pointed out. Possible future developments are suggested and four specific problems are put forward.

504. Tressler, D. K. Farm Res.[New York St.agric.Exp.Sta.],
1942, 8 (No.2), 15. Exp.Sta.Rec., 1942, 87,
305. Canner, 1942, 94 (No.20), 28.

PROBLEMS OF FOOD PRESERVATION MULTIPLY IN WAR-TIME. Notes a new interest in freezing fruits and vegetables. Deals with advantages of dehydration and the necessity for scalding vegetables before canning, freezing or dehydrating. Indicates work in progress at the New York State Agricultural Experiment Station on dehydration of vegetables, particularly studies of losses of vitamins and other nutritive values which occur during preparation of vegetables and subsequent dehydration, as well as during storage of the dried products under various conditions, the degree of scalding required to ensure maximum retention of vitamins and methods of indicating when this degree has been attained. Consideration is also to be given to the varietal adaptability of vegetables for dehydration (see Vol. 16, Abstr. 752). A small experimental dehydration plant is to be constructed to investigate the quality and yield of products. Packaging studies are also contemplated

505. Vahl, L. and Jansen, A. W. Polst.-en. Weekbl., 1942, 22, 91 and 131.
Chem. Zbl., 1942, 11, 1069.

VEGETABLE DRYING (transl. title). Discusses the relative value of freezing and drying processes, comparing quality demands, blanching (especially by the Jansen-Warkspoor method), development of the dehydration process, importance of the water content of the product and packing.

506. Woodroof, J. G., Darsee, N. E. *Georgia Agric. Exp. Sta. Bull. No. 224*,
and Thompson, H.H. 1943. *Exp. Sta. Rec.*, 1943, 89, 263.
DEHYDRATION OF FRUITS AND VEGETABLES AND THEIR USES. With
particular reference to Georgia conditions, a list is given of
30 vegetables and 5 fruits commonly grown in that State and suit-
able for dehydration in community drying plants. Procedures for
preparing, sulphuring and packing fruits and vegetables are
described, and varieties suitable for dehydration are noted.
Methods for rehydrating and cooking dried fruits and vegetables
are given.

Blanching and Sulphuring

507. Anon. *Chem. Zbl.*, 1938, 11, 2199. *Chem. Abstr.*,
1940, 34, 5194.
Reports that carrots, seeds and potatoes, blanched with 2 to 3%
sodium chloride solution after drying, were definitely hygroscopic
and therefore kept less well than those blanched in pure water.
508. Green, Culpepper, *Fruit Prod.* Jul. 1946 26.1.15-20.
Caldwell Hutchins 2.39-44.61.3.81-6. *Chem. Abstr.* 42.8994
20.11.48.
USE OF SO₂ IN DEHYDRATION OF EASTERN POTATOES AND OTHER VEGETABLES.
REVIEW of sulphuring in drying of fruits and vegetables.
Experimental work on efficiency of dosages, and methods of applica-
tion in controlling discoloration, heat injury, and storage
deterioration. Results show that SO₂ is more rapidly absorbed
and more firmly held in vegetables. Care necessary to prevent
overdosage. Difference in acidity may account for this. Amount
absorbed depends on sulphuring media; none has universal applica-
tion. Medium affects residual amount after cooking. Acid
dipped samples likely to be rendered inedible.
509. Cruess, W. V., Friar, H. *Fruit Prod.* J., 1943, 23, 113.
Balog, E.
NOTES ON CABBAGE DEHYDRATION. Results of experiments in
2 commercial dehydrators on the sulphiting of cabbage showed that
(1) considerably stronger solutions were required for sulphiting
cabbage before than after blanching, (2) sulphited cabbage with-
stood a higher finishing temperature than is now used for
unsulphited cabbage, (3) either spraying the cabbage with
sulphite solution or dipping it in the solution was effective,
(4) dried cabbage containing initially 2180 to 2500 p.p.m.
sulphur dioxide retained flavour, odour and colour fairly well
after 3 months' storage at room temperature and (5) bisulphite
may be more effective than sulphite or a mixture of equal
proportions of sulphite and bisulphite in preventing scalding or
flavour and odour of dried cabbage during storage.

510. Ermilov, S. A. Konserv. Plodov. Prom., 1938, No. 2, p. 21.
Chem. Zbl., 1938, 11, 2199. Chem. Abstr.,
1940, 34, 5194.
THE EFFECT OF BLANCHING IN SALT WATER ON THE KEEPING QUALITIES OF DRIED VEGETABLES. (transl. title). Reports that carrots, beets and potatoes, blanched with 2 to 3% sodium chloride solution after drying, were definitely hygroscopic and therefore kept less well than those blanched in pure water.
511. Hemmeter, G. T. Food Industr., 1943, 15 (No. 11), 137.
NEW DEVELOPMENT IN TECHNIQUE OF BLANCHING. A communication to the Editor from the Western Regional Research Laboratory of the U.S. Department of Agriculture concerning the method of blanching vegetables before dehydration. By forcing steam through a bed of the cut material, it was found that the rate of heat-transfer can be increased and entrapped air driven out, so that blanching can be carried out successfully in a thick bed of material. Preliminary experiments with carrot and white potato cubes are described. If a blancher were constructed to handle a bed of material at least 1 ft. thick, instead of the more usual $\frac{1}{2}$ to 1 in., the size of blancher required to handle a given tonnage would be reduced drastically.
512. Kanitz, H. R. and Z. Untersuch. Lebensmitt., 1940, 79, 372.
Dammann, E. Chem. Abstr., 1940, 34, 8093.
UEBER DIE EINWIRKUNG DES WASSERS AUF DIE VORBEHANDLUNG VON TROCKENGEMUSE. Investigations were made of the effect of the water used in blanching vegetables before drying on the condition of the dried product. Peas and Beans were blanched in (1) "soda-water" containing added soda and (2) "hygro-water" is claimed to result in a product with improved colour and quality and a 50% higher vitamin C content.
513. Kanitz, H. R. Z. Untersuch. Lebensmitt., 1941, 82, 430.
Chem. Zbl. 1942, 1, 1318. Chem. Abstr.,
1943, 37, 2837.
DER EINFLUSS DES IONENGEHALTES IM BLANCHIERWASSER AUF DEN BIOLOGISCHEN WERT VON TROCKENGEMUSE. (VITAMIN C UND SEINE NATURGEHEBENEN BEGLEITER. The importance of the ions present in the water during blanching, cooking and steaming on the biological value of dried vegetables is emphasized. The use of alkaline water or water hardened by the presence of carbonate was particularly destructive of vitamin C and related substances during preparation of dried vegetables. Adjusting the hardness of the cooking water by the "hygro-food protecting" process improved the quality of dried vegetables, $\frac{1}{2}$ of the vitamin C content being retained in the case of dried beans.

514. MacKinney, G., Friar, H. F. Fruit Prod.J., 1943, 22, 294.
and Balow, E.

EFFECT OF SULPHURING ON DEHYDRATED VEGETABLES. Discusses sulphuring as a means of preventing deterioration in dehydrated vegetables which may have to undergo storage at temperatures of 80°F (27.8°C) or higher for a few months. Recommends brief dips of not longer than 15 seconds, after steam blanching, in sodium bisulphite or potassium metabisulphite, composition of the dipping solution and concentration of sulphur dioxide in p.p.m. for the vegetable after blanching being given for asparagus, broccoli, carrots, cauliflower and cabbage. Tests showed that development of off-flavours in cabbage and carrots at 80°F (27.8°C) could be prevented if the product was sulphured, even although stored in air, in sealed containers, and that retention of ascorbic acid and carotene was greater. Control of sulphuring is necessary, since losses of sulphur dioxide are low from these non-acid, dried vegetables.

515. Mayer, J. C., Stotz, E. N.Y. Agr. Food Technology 1(2)252-5
Expt. Stn. Geneva N.Y. Apr. 1947.

THE BLANCHING OF VEGETABLES BY ELECTRONICS. The voltages, frequencies and times required for peas, carrots, and potatoes are given. Biological effects. Favourable retention of carotene and ascorbic acid, but provision must be made for rapid cooling (especially in cartons). Best on a belt with refrigerated air stream.

516. Proctor, B. E. Food Industr., 1921, 14 (No. 11), 51.

IMPLE TESTS BEFORE HYDROLYTIC BLANCHING. Tests used to determine the completeness of blanching of vegetables before drying should be carried out immediately the blanching process is finished. The 2 most common enzyme tests used for this purpose, the catalase and peroxidase tests, are described. The hydrogen peroxide used in these tests must be fresh.

517. Sugihara, J. Tan, S.T. Fruit Prod.J., 1941, 21, 104.
and Cruess, W.V.

EFFECT OF BLANCHING ON DEHYDRATED VEGETABLES. Investigations of the effect of blanching for different lengths of time in steam at various temperatures and in boiling water on the quality of dried vegetables indicated that (1) blanching before dehydration had a beneficial effect on colour, flavour, odour, texture and general cooking quality, (2) in most cases blanching in steam is preferable to that in hot water and (3) steam-blanching should be sufficient to practically pre-cook the product. Samples of the dehydrated vegetables were stored in sealed jars at temperatures of 80° to 85°F (27.8° to 29.4°C) for 6 to 12 months. Differences in colour, odour and flavour became more pronounced after several months' storage. Experiments with white and brown rice indicated that the latter must be packed in vacuo to prevent rancidification.

518. Sugihara, J. and
Cruess, W. V.

Fruit Prod. J., 1942, 21, 139.

EFFECT OF BLANCHING ON THE DEHYDRATION RATES OF VEGETABLES.

Studies of the effect of blanching on the time required to dry several vegetables showed that blanching in most cases caused an increase in the rate of drying; with cauliflower, peas and string beans the increase was appreciable. Blanching vegetables generally gave a lower yield than unblanched vegetables, notable exceptions being spinach and peas. Blanching peas were possibly case hardened. Cauliflower dried rapidly, whether blanched or not, and the product was satisfactory.

519. ———

A. I. C. Rept. 34 Western Region Res. Lab.
U. S. Dept. of Agric. Albany, California.

BLANCHING.

Vacuum Drying

520. Hommel, G. W.

B. P. 521, 189 (May 15th, 1940).

IMPROVEMENTS IN AND RELATING TO THE TREATMENT OF FOOD-STUFFS.

Vegetables (potatoes, etc.) are cooked and then dried under vacuum at a temperature not higher than 15°C and preferably at 40°C. During these treatments the vegetables are irradiated with visible and/or ultra-violet light.

Waste Heat

521. Anon.

Schneebeli J. Bull. S. E. V. No. 12. 1942.
Tekn. Tidskr. Uppl. B. Electrotechn.
No. 11. p. 167. 1942.

TORKNING AV FRUKT OCH GRÖNSAKER. A note on the process of drying fruit and vegetables by means of the ventilation air from generators in power stations. The only equipment required is wooden racks with drying boxes composed of a wooden frame with wire netting at the bottom, which are placed in the ventilation channels. Increased air resistance in the channels is compensated for by altering the regulating valves. Rise in temperature of the ventilation air is about 15°C. Such a plant can deal with 2 to 8 tons of fresh produce per week. It is intended for fruit and vegetables from private homes as well as public institutions, and delivery and dispatch are arranged by certain domestic organizations. The operation of the plant is carried out by the personnel of the power stations. Beans, spinach, tomatoes, onions and fruit (especially apples) are suitable for drying by this method.

522. Wharton, M. Food Industries 3,294-7(Jul.1931).
DEHYDRATING VEGETABLE PROCESSES. 4 dehydrators, 21 trucks of
 14 trays 3' x 4'. Heat from gas retorts. Capacity = 20,000 lb.
 prod/24 hr.

High Frequency Application

523. Miller, W. C. Mikower, B. J.Phys.Chem.49 801-22 Nov.1945.
RADIO FREQUENCY DIELECTRIC PROPERTIES OF DEHYDRATED CARROTS.
 Variations of Dielectric Constants of ground vegetables are
 discussed with respect to temperature, frequency and moisture
 content.
524. Rushton, E. Stanley, E.C. Chem.and Industr.No.35.274-6.
 Scott, A.W. 8 Sep.1945.
COMPRESSED DEHYDRATED VEGETABLE BLOCKS. APPLICATION OF HIGH
FREQUENCY HEATING. Cabbage and Pot-to blocks at 9% and 15% M.
 respectively in 3 x 3 x 1 inch blocks

$$\text{Power} = \frac{I^2 \tan \delta}{2\pi f C} \text{ (power factor)}$$

$$2\pi f C \text{ (frequency)}$$

 1½ to 2 hours for drying to 4% (cabbage) 3-4 hours for potato
 from 16% to 6% moisture. Under vacuum, about half these times.
 Costs of power consumed are given. 1 K.W. for 8 lb. potato or
 13 lb. cabbage.
525. Sherman, V. W. Elect.Comm.,1943,21(No.2),125.
 Chem.& Ind.,1943,62,372.Food Manuf.,
 1943,18,321.Nature,Lond.,1943,152,560.
DEHYDRATION OF FOOD BY RADIO FREQUENCY ENERGY. The Industrial
 Electronics Division of the Federal Telephone and Radio Corporation,
 in co-operation with the Office of the Quartermaster
 General of the United States Army, has developed a process of
 dehydrating food by means of radio frequency energy. It is
 claimed that the process makes it possible to remove 99% of the
 moisture from a compressed vegetable block, that vegetables
 dehydrated by this electronic process will not deteriorate over a
 period of 1 to 2 years, even in hot, humid climates, that
 reconstitution is simple and that vitamin content is little
 changed. The exact method cannot be disclosed at present, but
 it is stated that 90% of the moisture in the fresh vegetables is
 removed by the usual drying methods, the vegetables are then
 compressed into blocks and the remaining moisture removed
 electronically, after which they are wrapped in paper, wax-coated,
 packed and shipped. Results showed that 1 lb. of water can be
 removed electronically with less than 1 kilowatt/hour of energy.
 The moisture content of dried whole milk was also reduced
 electronically from 2 to 1%.

526. Sherman, V. W. Standard BP.606,882 20.10.44 B.III 137.Mar.1949.
Tel. & Cables.Ltd.

DEHYDRATION OF VEGETABLE FOOD PRODUCTS. The material, partly dried to 10-25% M, is made into blocks at 300-700 p.s.i. Several blocks are placed between horizontal dielectric heating electrodes in a container connected to a vacuum pump. Intermittent heating by frequencies, 10-29 megacycles/Sec. to produce a temperature of 43-66°C, a little air being admitted occasionally to remove water from the chamber. Drying to 1% moisture is rapid, uniform and economical. Vitamin retention and keeping qualities are good.

Domestic Drying

527. Anon. U.S.A. Dep.Agric.Fmrs' Bull.No.1918,
1942, Exp.Sta.Rec., 1943, 88, 130.

DRYING FOODS FOR VICTORY MEALS. Deals with procedure for the home drying of fruits and vegetables, stressing the importance of this method of preservation as a war-time measure for conserving sugar, metals, rubber and other materials. The importance of speed in the process, kinds of fruit and vegetables to dry, general directions concerning preparation for drying, equipment for steaming, methods of drying, containers and conditions for drying and preparation for table use are considered. Specific instructions for drying 10 fruits and 13 vegetables are given.

528. L'Office Federal Rev.Hort.Suisse.1940,13,202.Hort.
Switzerland Abstr.,1940,10,387.

LE SECHAGE DES FRUITS ET DES LEGUMES ET L'EMPLOI DES PRODUITS SECHES. L'Office Federal de Guerre pour l'Alimentation (Suisse). An article addressed to housewives, Women's Institutes, etc., in connexion with the utilization of all sound fruit and vegetables. Details are given of methods for drying fruits such as apples, pears, cherries and plums and vegetables and garden herbs. Products should keep for 1 to 2 years. Vegetables, some fruits and herbs should be hung in sacks in a well aerated dry place, shaken from time to time and protected from light. Vegetables and plants dried without previous part-cooking are liable to slight fermentation and should be placed in air-tight receptacles immediately after drying. Stone fruits and berries should be kept in boxes and well aired on sunny days. Green jars with wide necks are particularly suitable for storing dried products. Recipes for using the products are included.

529. Atkinson, F. E. and Dom.Canada Dep.Agric.Fmrs' Bull No.114
Strachan, C. C. (Publ.744),1942.

HOME PROCESSING OF FRUITS AND VEGETABLES. Describes processes for the domestic drying of fruits and vegetables, giving details of (1) construction and operation of the drier, (2) sulphuring of fruits and preparation of dried apricots, peaches, pears, prunes, cherries and grapes, (3) blanching of vegetables and preparation of dried beans, peas, spinach, sweet corn, soup mixture, vegetable powders (from leaf vegetables), tomatoes and dried fresh beef, (4) packing and storing of dried products and (5) preparation of dried products for the table. Method and equipment for sun-drying apricots, preparation of cherry raisins, candied fruit and varnishing cherries, methods for preparation of apple and grape juices

and of juices with suspended pulp (tomato, apricot, prune), preparation of apple syrup and pectin from apples and the process of making vinegar are dealt with also. The construction and operation of a fruit juice press are described and illustrated.

540. Bedford, C.L. Dobie, J.B. Washington Agric.Exp.Sta.pop.Bull.
and Smith, L.J. No.172, 1943. Exp.Sta.Rev., 1943, 89, 763.
HOME DRYING OF FRUITS AND VEGETABLES WITH THE W.S.C. DEHYDRATOR.
Drying is recommended only as a supplement to canning, freezing and storage. Considers methods of drying, selection of material and preparation and drying of fruits (including sulphuring) and gives specific directions for drying particular fruits. Deals with the preparation and drying of vegetables (including blanching), with specific directions for drying several vegetables, and the storage and use of dried vegetables. Plans and directions for construction of the Washington State College iron wire home dehydrator are given. In place of a fan for forced draught or thermostatic heat control, the radiant heat principle is used to ensure a more equal distribution of heat.
531. Beresford, H. Electricity on the Farm 8(9).p.10-11
1935.
A fruit and vegetable dryer suitable for the needs of the farm family.
532. Davis, S.G. Esselen, W.B. Jr. Massachusetts agric.Exp.Sta.
and Griffiths, F.P. Bull.No.404, 1943. Exp.Sta.Rec.,
1943, 89, 763.
HOME DEHYDRATION OF VEGETABLES. Discusses the possibilities of home dehydration as a practical method of food preservation and gives plans and constructional details of home-built, natural-draught and forced-draught dehydrators of various sizes. Presents general directions for dehydrating vegetables, as well as specific directions for individual products, and deals with packaging and rehydration. A comparison of costs of dehydration and canning indicates that the former is relatively economical, but common storage of root vegetables is still more economical and various problems, including time required and home storage methods for retaining satisfactory quality, make it unlikely that dehydration will replace canning and freezing in the home preservation of food.
533. Davis, S.G. Esselen, W.B. Jr. Food Industr. 1943, 15 (No.5), 54
and Griffiths, F.P. and (No.6), 53.
SMALL DEHYDRATORS FOR VEGETABLES. Discusses general factors which govern small-scale or home dehydration of vegetables and gives details of 2 small dehydrating units, i.e. (1) natural draught and (2) forced draught types. The functions of air, heat and humidity in the dehydration process are considered. The design of a efficiently larger batch dehydrator (adapted for use by several families) is described and illustrated. Preparation of the tables for drying, dehydration procedure, operational costs and maintenance are dealt with.

534. Grène, G. Rev.hort.Suisse,1942,15,221. Hort.
Abstr.,1943,13,80.
LE SERVICE DE SÉCHAGE DES FRUITS ET DES LÉGUMES DE LA VILLE DE GENEVE. Gives an account of a recently established municipal service in Geneva for the dehydration of fruits and vegetables belonging to the citizens. The produce is returned to its owners when the process is complete. The inhabitants take full advantage of the installation and considerable saving of foods, which would otherwise have been wasted, has been effected. Only produce likely to give good results is accepted.
535. Heinzelmann, T. Bull.Ass.Suisse Elect.,1940,31,331.
Engng.Index,1940,p.484.
"DÖRREN VON OBST UND GEMUSE MITTELST ELEKTRISITÄT. Deals with the drying of fruit and vegetables by means of electricity, with numerical data on drying for domestic and small-scale commercial use, and gives a description of equipment.
536. Hilde, S. Obst-u.Gemüse-Verwert-ungsind.,1941,
28,432. Chem.Zbl.,1942.1.430.
EIN NEUES TROCKNUNGSVERFAHREN. Refers to the cold drying process of Lechner, and describes a domestic drying cabinet in which kieselgur is used, for drying plant tissues. The kieselgur, having absorbed the moisture, can be regenerated by heat.
537. Peile, R. M. J.Dep.Agric.Vict.,1942,40,437.
VEGETABLE DRYING. Gives some details of domestic methods of preserving vegetables by drying.
538. Schnaller, J. A. Agric.Engng,St.Joseph,Mich.,1943,24,86.
Food Industr.,1943,15(No.4),56.
COMMUNITY FRUIT AND VEGETABLE DEHYDRATOR. Studies are being made of the development of equipment for dehydrating products on a community scale and to determine the best method of preparation, processing, storing, refreshing and cooking. Describes a cabinet type of dehydrator, consisting of (1) a top section, or fresh and return air duct, containing the heating unit, fan and air-intake damper, and (2) a bottom section, or drying tunnel, containing drying trucks, loaded with sliced food crops, and an exhaust-air damper. Gives tables showing (1) capacity of a 20-quadrant dehydrator for various products and evaporation rate and (2) full load tests with green beans and apples in a community dehydrator. Gives in detail when can be obtained by converting community canning plants to community dehydrators in shown.

DEHYDRATION OF FRUITS AND VEGETABLES IN THE HOME. Discusses home methods of drying foods and principles which govern successful dehydration. The need for care in selection of materials is emphasized. A satisfactory type of home dehydrator is described and directions are given for the preparation, dehydration, packaging and rehydrating of many fruits and vegetables.

SULZER BROTHERS INSTALL A DRYING PLANT FOR FRUIT AND VEGETABLES GROWN BY THEIR EMPLOYEES. A Note on a plant installed by the Central Heating Department of Sulzer Brothers at Winterthur, Switzerland, for the use of their employees to dry surplus fruits and vegetables. Drying is done by hot air in 2 separate units, each consisting of a well-insulated chamber, upon which is erected the hot air apparatus composed of a narrow tube air heater in which hot water is delivered from the boiler-house circulates. Air is drawn through the heater by means of a low pressure fan, then delivered to the drying chambers and finally drawn off to resume circulation. Each drying unit is subdivided into 7 cells, each containing 18 horizontal trays. The 252 trays which the 2 ovens will accommodate provide a total drying surface of 2,150 sq. ft., and, if both ovens are used, from 2000 to 4000 lb. of fresh fruit and vegetables can be dried in 24 hours, the exact quantity depending on the product. Drying times required for damson-plums, whole pears, beans and other vegetables are given. 1894).

Costs of drying

BETRIEBSERFAHRUNGEN MIT ELEKTRISCHEN DORRANLAGEN. Gives an account of experience in the drying of fruits and vegetables by means of electricity and discusses operation and costs of drying installations with and without artificial air circulation, and installations in which waste heat is recovered, with brief notes on construction and details of electrical driving equipment. (Taken from a report prepared by the Committee for Electric Heating of Swiss S.E.V.)

542. Christie, A. W. Food Industries 3, 478-80 (1931).
DEHYDRATION COSTS FOR FRUITS AND NUTS. 1900 modern airblast dehydrators now used in Cal. "Dehydration as contrasted with merely "drying" may be defined as evaporation of excess moisture in a current of air, the temperature, humidity and flow being neglected. Prunes: Average overall eff. 45% oil; 65% elec. - cost 6x for el. Walnuts - el. best successful - low temperature. 110° F. only 20% moisture.
543. Eidt, C. C. Food in Canada, 1943, 3 (No. 9), 9.
DEHYDRATION COSTS. Discusses costs of dehydration, as compared with those of canning, or freezing, with reference to costs of equipment, raw products and apply drying, and compares costs of fresh and dried products.
544. Ramage, W.D. and Food Industr., 1943, 15 (No. 7), 64, (No. 8),
 Rasmussen, C.L. 66 and (No. 9), 75.
THIS IS WHAT IT COSTS TO DEHYDRATE VEGETABLES. Deals with dehydrating costs for plants of the (1) multi-stage tunnel type, (2) counter-flow tunnel type and (3) conveyor type of 25 to 100 tons daily capacity, handling potatoes, carrots and rutabagas. Features of design, construction and operation of the plants are discussed. Capacities per unit of time at various points along the processing line are also given for 7 vegetables, as well as approximate utility requirements for dehydration plants of various sizes. Processing costs and factors which affect them are considered.

Vegetables various

545. Hall, L. A. Food Inds. Vol. 8 p. 19. 1936.
ASPARAGUS BUTTS MADE USEFUL. Butts amount to 10-15% of stalks. This, when dried and powdered, makes a useful soap. Oven dried on electrically heated wire mesh trays. Full process data, and data for steam heating for drying on a large scale are given.
546. Cruess, W.V. Friar, H.F. Canner, 1943, 97 (No. 1), 18.
 and Balog, E.
THE DEHYDRATION OF SNAP BEANS. Deals with the experimental dehydration of 11 varieties of snap or string beans. Tender pods of uniform maturity were trimmed, cut cross-wise into equal lengths, washed, placed on Monel screen trays and blanched in live steam for 10 minutes. They were then dried for 2 hours at a temperature of 120°F (71.1°C) in a tunnel dehydrator, through which heated air passed at a rate of 500 ft. per minute, and finally heated at 140°F (60°C) to dryness. After storage for 6 months at room temperature in air, samples were refreshed in water and cooked. Data on drained weight before and after cooking, flavour, colour and texture are given. In general,

bush beans of the Stringless Green Pod type gave the best product on refreshing. Dehydrated beans were kept satisfactorily in air for 3 years and packing in sealed moisture-vapour-proof containers appeared adequate. Various methods of blanching were investigated. The problem of vitamin retention is discussed.

147. Friar, H.F., Balog, E. Canner, 1943, 97 (No. 2), 12.
and Cruess, W.V.

EXPERIMENTAL DEHYDRATION OF PRE-COOKED BEANS. Beans, soaked in water overnight, then cooked until well done, but still whole and firm, were dehydrated on Monel metal trays; when nearly dry, they were mixed with the small amount of liquid which remained after cooking, after which drying was completed. Several varieties of dry bean were compared as to time required to cook and condition after cooking (1) in steam and (2) at a temperature of 240°F (115.5°C), and the drying times and ratios on treatment in a forced draught laboratory dehydrator were determined. Several methods of cooking and drying and rehydrating tests are discussed.

148. Caldwell, J.S. and Culpepper, C.W. Canning Age, 1943, 24, 309,
363 and 420.

SNAP-PEAN VARIETIES SUITED TO DEHYDRATION. Reports studies of 12 varieties of snap-bean to determine their comparative suitability for dehydration. Each variety was dried at several stages of maturity. After preparation and blanching, the material was dried in a steam-heated tray drier of the inclined tunnel type. Tabulated results show the relation of stage of development, as measured by weights of pod and seeds and percentages of pericarp and seeds making up the pod, to yield, colour and appearance of the dehydrated product and to amounts of water absorbed in soaking and cooking. Describes the method of grading in the cooked condition and discusses stage of maturity in relation to quality, flavour or palatability, texture of pericarp and colour and general attractiveness. Control or prevention of discoloration and methods of blanching are also dealt with.

149. Knauth, A. Obst-u. Gemüse-Verwertungsind., 1940, 27,
502. Chem. Zbl., 1940, 11, 3719.

UNTERSUCHUNGEN ÜBER DIE HERSTELLUNG VON TROCKENBOHNEN. Large-scale tests in a 200-litre blanching vat with hygro-nutrient-protection water (Hygro-Nährschutzwasser), in comparison with tap water and soda water, showed clearly the superiority of the hygro process in the preparation of dried beans. The blanching water was light in colour and only slightly turbid. The dried beans were equally glossy after treatment with tap water and with hygro water, but markedly superior in colour after blanching with hygro water; soda water changed the colour to an unnatural grass-green. After swelling and cooking the dried beans, those blanched with

tap water had a bleached colour, those blanched with hygro water swelled most rapidly, retained their colour and had a pleasant flavour, while those blanched with soda water had an unnatural colour and grassy flavour. On swelling and cooking the dried green beans in hygro water, it was found that this water, as compared with tap water and soda water, produced a lighter colour, better texture and outstanding swelling ability of the beans and greater clarity of the cooking water.

550. Anon. Canner, 1943, 97 (No. 24), 13.
A BASIS FOR ECONOMICAL DEHYDRATION OF CABBAGE. A contribution from the Western Regional Research Laboratory of the U.S. Department of Agriculture, giving a diagram showing the processing stages in the dehydration of cabbage and outlining general requirements as regards building and equipment, choice of drier, loading and stacking trays, packaging equipment and labour.
551. Mallette, M. F. et.al. Ind. Eng. Chem. 39 (10) 1345 1947.
COMMERCIALLY DEHYDRATED CABBAGE. Oxidative Enzymes and other factors.
552. Allen, R.J.L., Barker, J. J. Soc. chem. Ind., Lond., 1943, 62, 145.
and Mapson, L.W.
ADDENDUM. Cruickshank, E.M.
THE DRYING OF VEGETABLES. I. CABBAGE. The first of a series of papers describing investigations the object of which was to devise methods for the production of dried vegetables which have high culinary quality and nutritive value and retain these properties on storage. The present paper describes methods for drying cabbage, special attention being paid to retention of colour and ascorbic acid. Observations were made of the effect on ascorbic acid content of the treatment at every stage of processing from preparation of the raw material to cooking of the dried product. Procedure is described for preparation of cabbage (i.e. trimming, shredding, washing), single or serial scalding or "blanching" in tap water, in solutions of sodium sulphite, ascorbic acid or sodium chloride, in extracts made from outer waste leaves and stalks and in steam, and drying in a cabinet on trays, over which was circulated a current of hot air, to an average water content of about 5%. The effect of processing on the carotene and vitamin B₁ contents of cabbage was also examined. Results of comparison of the chemical and biological assay of vitamin C in cabbage dried in presence of sulphite are given in the addendum.

553. Paikina, S. Sn.

Konserv.Flodo-ov.Prom., 1940, 11 (No.4),
19. Chem.Zbl., 1941, 11, 282. Chem.Abstr.,
1944, 38, 1578.

VITAMIN C IN DRIED CABBAGE (transl. title). Drying cabbage at room temperature up to 60°C did not affect the vitamin C content, but at higher temperatures there was considerable loss. Storage in damp places and a water content of more than 6 to 8% caused losses of vitamin C as high as 95%. There was little loss of vitamin C after boiling in closed containers for 25 and 40 minutes. In the determination of vitamin C by Devyatnin and Doroschenko's method, it is necessary to introduce hydrogen sulphide after treatment with lead acetate. Only when the cabbage is free from dehydroascorbic acid can both treatments be omitted.

554. Paikina, S. S.

Voprosy Pitanya (Probl.Nutrit.,
U.S.S.R.), 1940, 9 (No.6), 38. Nutrit.
Abstr.Rev., 1942, 11, 422.

THE EFFECT OF DRYING ON THE STABILITY OF VITAMIN C IN CABBAGE (transl. title). When cabbage was dried at temperatures of 25 to 40°C, loss of vitamin C was not great, but if the temperature was raised above 70°C, serious loss occurred. There also appeared to be greater loss of vitamin C during the drying of young cabbage in November than when old cabbage was dried in January. These findings may be related to the optimum conditions for activity of ascorbic acid oxidase. Retention of vitamin C in dried cabbage, stored in parchment wrappings in boxes at room temperature, was better in samples with low moisture content than in those containing more than 10% moisture. Other samples stored in wooden boxes at room temperature lost almost all their vitamin C activity in 2 months. There was no further loss of vitamin C when dried cabbage was cooked.

555. Anon.

Food Industr., 1943, 15 (No.2), 64.

DEHYDRATION OF VEGETABLES-CARROTS. Gives an illustrated account of the preparation of dehydrated carrots at the plant of the Beech-Nut Packing Coy., Rochester, New York.

556. Clark, N. L.

Canning Age, 1943, 24, 84.

CONTINUOUS TUNNEL DRYING AT BEECH-NUT PLANT. An illustrated article describing the dehydration of carrots as carried out at one of the Beech-Nut Corporation plants. Steps of the drying operation are (1) washing the raw carrots, (2) searing the outer surface with flame peelers and removing charred peel by a strong spray of water, (3) inspecting and trimming, then washing and slicing the carrots, (4) pressure blanching in a steam retort or continuous steam blancher, (5) spreading on to dehydrator trays and loading the trays into tracks, (6) passing through the tunnel

dehydrator (or cabinet drier) and then into finishing bins,
(7) final inspection of the dried product and (8) packing into
cans, which are either sealed under vacuum or filled with carbon
dioxide.

557. Wilson, R.H., Thomas, J.O. Fruit Prod., 1942, 22, 15.
and Deeds, F.
VITAMIN A VALUE OF FRESH AND DEHYDRATED CARROTS. Results of
determinations of α -carotene and bioassays with albino rats
showed that the loss in pro-vitamin A which occurred on dehydra-
tion of carrots was not serious.
558. Tomkins, R.G., Wager, H.G., B.P. 603,997, 20.11.45 B.III.444.
Mapson, L.W. Dec. 1948.
DRYING OF CARROTS. Retention of colour, flavour and carotene
content improved by scalding in 20% starch solution prior to
drying, instead of plain water. Double storage life. Any
starch is likely to be suitable.
559. Legault, R. R. et. al. Ind. Eng. Chem. 39, 1294 1947.
DEHYDRATED CARROTS. BROWNING DURING STORAGE.
560. Miyayoshi, H. and J. agric. chem. Soc. Japan, 1940, 16, 1098.
Kawakami, K. Bull. agric. chem. Soc. Japan, 1940, 16,
164 (Abstr. in English) Brit. chem.
physiol. Abstr. B. III, 1941, p. 102. Chem.
Abstr. 1941, 35, 6685.
ON THE VITAMIN CONTENTS OF DRIED MUSHROOMS PRODUCED IN MANCHOUKUO
(transl. title). The amounts of vitamins B₁, B₂ and C and
ergosterol in *Pleurotus serotinus* (Schrod) Fr., *Armillaria mellea*
(Vahl) Fr. and *Cortinellus Shiitake* were determined.
561. Brunell, H.J. Esselen, W.B. Jr., Food Industr., 1943, 15 (No. 11),
and Griffiths, F.P. 74.
METHODS FOR QUICK-FREEZING AND DEHYDRATING MUSHROOMS. Results
showed that commercially grown mushrooms (*Agaricus campestris*)
can be dehydrated so that, on reconstitution and cooking, they
compare favourably in flavour and appearance with fresh mush-
rooms. The mushrooms should be thoroughly cleaned in cold
water, cut into pieces, blanched for 2 minutes and 15 seconds
and dried at a temperature of 145° to 150°F (62.78° to 65.56°C)
to a moisture content of 5% or less. The dehydrated product
should be packed in moisture-proof containers and stored at
75°F (23.89°C) or lower. The thiamine, riboflavin and
nicotinic acid contents of mushrooms were found to be stable
during dehydration and storage of the dried product. Quick-
freezing also yielded a satisfactory product, in which thiamine,
riboflavin and nicotinic acid were well retained.

552. Botticher, E. W. Pannwitz, P. Vorratspflege u. Lebensmittelforsch.
und Nier, E. 1941, 4, 448. Chem. Zbl., 1941, 1, 3147.
DIE VERWERTBARKEIT DER IN DEUTSCHEN WALDEN WACHSENEN PILZE ALS
LEBENS- UND FÜTTERMITTEL. Deals with the utilization of mushrooms
and animal food. Dried mushrooms can be prepared for use
as seasoning in foods. Evaporation and drying must be carried
out in vacuum to preserve the aroma. Iron-plate containers have
not proved suitable for canning mushrooms. Good results were
obtained by ensiling mushrooms (with addition of sour milk, with
or without sugar) in barrels and pits. Mushroom powder prepared
from the expressed residues was found to be useful addition to
fodder for pigs and did not affect the flavour of the meat.
Mushroom meal also proved useful in feeding fish.

563. Lees, P. M. Propag. rur., Montevideo, 1941, Feb. Hort.
Abstr., 1941, 11, 248.

TIENE INTERÉS POR RESULTA DESECADA EL MERCADO DE LONDRES.
Describes the preparation of dried onions for the London market.
Thin slices are immersed in salt solution for 3 to 5 minutes and
then dried on trays in tunnel driers at a temperature preferably
below 60°C, although kiln driers might serve. The final moisture
content should be 5 to 7%. Onion powder is produced by grinding
after drying and is shipped in tin-lined cases holding 2 cwt.
each. An illustration is given of a drier in use in Montevideo.

564. Anon. Bull. Imp. Inst., Lond., 1940, 38, 324.
Nature, Lond., 1940, 146, 772.

DRIED ONIONS. Gives details of a method of preparing dried
onions. After trimming, peeling and slicing and, if desired,
immersion in salt solution, onion slices are dried at a tempera-
ture not higher than 140°F (60°C), usually on trays in tunnel
driers, for 8 to 10 hours until the product is crisp and dry with
a moisture content of 5 to 7%. For production of powder, the
slices are ground by hammer mill after drying. Sun-drying is
said to give less satisfactory results than artificial drying.

565. Szabó Béla Bull. Fac. Hort. and Viticulture Univ.
Agr. Sci. Buda Pesth. 10 185-7 (1944)
Publ. 1945 Chem. Abstr. 44 (12) 5494.
June 1950.

A DRYING EXPERIMENT WITH PAPRIKA.

566. Caldwell et. al. Canner 1946 103 (13) 13, (14) 30, (15) 20,
C.A. 41 7010. 1947.

THE DEHYDRATION OF PEAS. Moisture relations, nutrient elements on
storage. Larger size peas appear to possess advantages over
small size peas in all respects.

567. Ede, A. J. J.S.C.I. Dec. 1949.
See under FREEZE DRYING. (Peas)
568. Caldwell, Culpepper et al. Fruit Produce Jul. 27 1948
B. III. 330 Oct. 1948.
UTILISATION OF SWEET PEPPERS. I. Blanching by steaming or boiling is preferable to drying raw. Method of drying not given.
569. Culpepper, Ezell, Wilcox, Fruit Prod. J. 1948 27 346-350-35.
and Hutchings.
UTILISATION OF SWEET PEPPERS. II. Delygration. Summaries of qualities of 49 varieties, and suitability for dehydration. Best varieties are also the best for canning.
570. Cruess, W.V. Balog, E. Canner, 1942, 95 (No. 24), 13.
and van Holten, P.
DEHYDRATION OF SAUERKRAUT. Outlines earlier experiments on the dehydration of sauerkraut (see Vol. 13, No. 1700; Vol. 14, No. 713) and gives results of tests in which sauerkraut was dried with and without juice. Drying with the juice increased yield and nutritive value per pound of fresh, drained kraut used and improved the flavour. Exposing steam-blanchd kraut to sulphur dioxide fumes for 20 minutes before drying resulted in better retention of vitamin C and lighter colour than were obtained in untreated kraut. A method of compressing dried sauerkraut into blocks is described. The total acidity of fresh and dried kraut is given.
571. Echeverria, J. Rev. Fac. Agron. Univ. Montevideo, 1941,
No. 25, p. 117. Chem. Abstr., 1943, 37, 1522.
DESHIDRATACION DE HORTALIZAS-"SOPE JULIENNE". The preparation and chemical composition of some dried vegetable products are discussed. General principles involved in the preparation of a "Julienne" soup mixture are dealt with and technique for treatment of each vegetable is described in detail.

Vegetables powdered

572. Hohl, L. A. and Haas, V. A. Fruit Prod. J., 1943, 22, 305.
EXPERIMENTS WITH DEHYDRATED POWDERED VEGETABLES. Describes several methods of dehydrating and powdering carrots, spinach, asparagus and peas, the resulting products having a moisture content not above 5%. They were reconstituted and compared with each other and with commercially canned samples with regard to colour, flavour, texture, consistency and palatability. Asparagus, peas and spinach were best when blanched, made into purées and drum-dried. Carrots were best when powdered in a hammer mill after dehydration. Several pre-cooking treatments

were compared on vegetables which were dehydrated in a forced draught tunnel drier at a temperature of 140° to 150° F (60° to 65.55° C) until completely dry and then powdered. A short blanch in flowing steam was most effective in preserving flavour, texture and keeping quality. Colour and re-construction ratios were best in unblanched samples. Vegetables prepared in this manner appeared to be acceptable to children.

573. Hohl, L. A. Canner, 1943, 93 (No. 23), 12.
DEHYDRATED VEGETABLE POWDERS FOR USE AS BABY FOODS. Discusses the possibilities of preparing powdered vegetables for use as baby foods, soup stock, etc. to replace canned, strained vegetables. The vegetables may be either puréed and then dehydrated or dehydrated whole or in pieces and then ground to a powder. Methods used for preparing carrot, spinach, asparagus, pea and other vegetable powders are described.
574. Maus, K. B.P. 505,721 (May 16th, 1939)
AN IMPROVED PROCESS FOR DEHYDRATING COMMINUTED POTATOES AND ROOT CROPS. Ground products (e.g. potatoes, carrots, beets, turnips) are arranged in several superposed layers in press chambers, the surfaces of the chamber and of each layer are strewn with ground absorbents having an emulgent action (e.g. dried potatoes, hay meal, husks, barley chaff, etc.) and the material is then pressed to remove moisture. The pressed material, containing about 30% moisture, is ground, mixed with starch-binding ground rodder (e.g. dried hay meal or blood or meat, bone or fish meals) and again pressed to prevent fermentation or discoloration a powder or liquid (e.g. alum, sulphurous acid or hydrogen peroxide) may be spread over the material before grinding.
575. Barker, J. B.P. 542,125 (December 29th, 1941. Mod. Refrig., 1942, 45, 27.
IMPROVED PROCESS FOR PRODUCING STARCHY VEGETABLE PRODUCTS IN DRY POWDERED FORM. The process involves an initial cooking, followed by a drying process, which comprises mashing or mincing the cooked material without previous cooling, allowing the mass to stand for a conditioning period, during which its tendency to develop a sticky character is reduced or eliminated, and thereafter drying at a suitable temperature.
576. Röttinger, A. C. B.P. 508,751 (July 5th, 1939).
IMPROVED MANUFACTURE OF DRIED VEGETABLE PRODUCTS. Before drying on roller driers, fresh vegetables are ground and mixed or kneaded into a paste or dough with egg yolk or milk or soya, the dried preparation being ground as required. Cereal flours may also be included. Examples are given of the preparation of spinach powder and vegetable flakes.

577. Volpertas, Z. B.P. 525,043(August 20th,1940).
PROCESS FOR REDUCING VEGETABLES CONTAINING STARCH TO A FINE POWDER. Claims an improvement in the procedure described in B.P. 496,423 (see Vol. 11, No. 311). Farinaceous vegetables such as potatoes are cooked and then dried in powder form, powder obtained from the same vegetable being added to the freshly boiled vegetable before further treatment or after it has been reduced to a damp powder. The mixture is heated, e.g. in a drum provided with a stirring device, until it is perfectly dry and the treatment may be carried out in vacuum. It was found that particles of the product so obtained are less liable to adhere to one another during drying.

Vegetables compressed

578. Dunlap, W. C. Ind.Eng.Chem.1946 38 1250-3.
COMPRESSED BLOCKS. Dielectric drying is more rapid than conventional methods but quality suffered somewhat.
579. Miller, M. W. U.S.P.2,406,431 27.8.46.
Assr. to Basic Vegetable Products Co. Appl.,30.7.41.
DEHYDRATION OF VEGETABLES. To facilitate formation of bricks of brittle vegetables, the dehydrated product (onion, garlic) at 3% moisture is allowed to adsorb 0.2 - 0.3% of moisture prior to briquetting.

Packaging and storage

580. Anon. Mod.Packaging,1943,16(No.5),52.
PACKING AND STORING DEHYDRATED VEGETABLES. An illustrated article summarizing methods of packing and storing dehydrated vegetables. Tin-plate cans, hermetically sealed for certain dehydrated vegetables or with friction tops for others, are widely used and are preferred. Problems of sealing the cans and procedure for packaging in air, in carbon dioxide or in nitrogen, the carbon dioxide "snow" method and the vacuum bell method are dealt with. Control of insect infestation, labelling and packing, and marking of shipping containers are mentioned briefly. Storage of cases of dehydrated vegetables at the dehydrator is discussed.
581. Barker, J. Tomkins, R.G. U.K.Progress Rept.Oct.1943
Allen, R.J.L. Mapson, L.W. "Dehydration" T.S.I.R., and Min. of Food VI.2.pp.1-21.
PACKING AND STORAGE OF DRIED VEGETABLES.

582. Davis, M.B. and Phillips, W.R. Food in Canada, 1943, 3 (No. 4), 23.
PACKAGING METHODS FOR DEHYDRATED VEGETABLES. Outlines recent developments in packing and compression methods. Presents data for the packing of potatoes, carrots, turnips and cabbage, and describes the method of compression. Discusses investigations to find substitutes for metal, and preliminary tests on a foil package.
583. Dunker, et al. Food Techn. 1. 17-18-1947. B. III. 286. Sept. 1948.
 Relation of moisture content to quality retention during storage.
584. Heise, R. and Wolf, J. Tätigkeit des Kältetechn. Inst., Karlsruhe, 1 Oct., 1937 - 31 Mar., 1939, p. 113. Landw. Jb., 1939, 88, 941.
LAGERING VON PROKENGEMUSE. A prower-ss report of studies of the keeping quality of various dried vegetable products (sliced beans, Savoy cabbage, carrots, "Julienne" mixed vegetables and potatoes), with special reference to the swelling ability of dried beans (packed loose), water content and swelling ability at room temperature of various products (pressed at time of preparation or packed loose) and vitamin C content of dried vegetables (prepared in both pressed and loose form) during storage at temperatures of -18° and 15°C . The work is being continued.
585. Legault, et al. Ind. Eng. Chem. 1949 39 10. 1294-99.
BROWNING OF DEHYDRATED VEGETABLES DURING STORAGE. As a function of temperature, moisture, content and confining atmosphere. Potato, onion, carrot, cabbage, sweet potato, are dealt with.
586. Logan, P. P. Canning Age, 1942, 23, 514.
DEHYDRATED FOODS. Discusses methods recommended by the U.S. Quartermasters' Corps for preparing, drying and packing dried vegetables to ensure products of good quality. Tables are given to illustrate the savings in tonnage and space which may be accomplished by the use of dehydrated foods.
587. Mathieson, E. Jacobsen, F. Tidsskr. Kemi. Bergv. Met., 1941, 1, 91. and Solvig, K. Che., Abstr., 1941, 35, 8136.
VITAMIN C IN DRIED VEGETABLES. II. EFFECT OF STORAGE AND OXIDATION. (transl. title). The behaviour of vitamin C in dried vegetables stored under different conditions was studied. Samples stored in vacuum showed no change in vitamin C content after 7 months. Samples stored in the original packing material and in wax-sealed glass tubes showed an initial oxidation of ascorbic acid into dehydroascorbic acid, which was further

oxidised to biologically inactive compounds. Simultaneously, the ascorbic acid was oxidised. After 6 months the vitamin C content was reduced to 50%. In biological determination of vitamin C in dried vegetables, the calculated daily amounts of vegetables for feeding must be based on a chemical titration of ascorbic and dehydroascorbic acids, as considerable amounts of vitamin C are oxidised rapidly during soaking of the powders in water.

588. Pitman, A.L., Rabak, W., Food Industr., 1943, 15(No.1), 49.
and Yee, H.

PACKAGING REQUIREMENTS FOR DEHYDRATED VEGETABLES. The effect of moisture content of dehydrated vegetables on their keeping qualities and the necessity for eliminating oxygen from the package are discussed. Temperature, light and insect infestation also affect storage properties. Requirements for an ideal package of dehydrated vegetables are outlined. Measurements of resistance to moisture-vapour and of permeability of seals or seams are described. The selection of package linings is dealt with and some specifications are suggested for substitute packages for military use.

589. Tomkins, R. G. L.T.R.S.Memo.No.231 July 1950.
D.S.I.R./4351/C.

THE USE OF LIME AS AN "IN-CAN" DISINFECTANT FOR DRIED VEGETABLES.
Results of tests at 37°C, 28°C and 15°C.

Nutritional aspects

590. --- U.K.Progress Rept.Oct.1943
Dehydration.D.S.I.R.,Min.of Food VI
part 3.pp.1-18.

FACTORY EXPERIENCE IN DRYING VEGETABLES. Results of pilot scale experimental work, with details and diagrams and operation of tunnel and conveyor dryers, and of trials therein. Suggested equipment for new factories.

591. Allen, R. J. L., Mapson, L. W. U.K.Progress Report Oct.1943
Dehydration.D.S.I.R.and Min. of
Food VI part 4 pp.1-15.

THE NUTRITIVE VALUE OF DRIED VEGETABLES. Several tables of

592. Parker, J., Hulme, A.C. U.K.Progress Report.Oct.1943
Brightwell, S.T.P. Bend, G. Dehydration.D.S.I.R.and Min.of Food.
VI part 5.pp.1-19.

THE STANDARDISATION OF QUALITY OF DRIED VEGETABLES.

HOME DRYING METHODS AND THEIR EFFECT ON THE PALATABILITY COOKING QUALITY AND NUTRITIVE VALUE OF FOODS. A progress report on work in progress to investigate (1) equipment and methods used in domestic dehydration, with reference to types of drier, vegetables chosen for drying and their preparation, the drying process, tests for dryness and packages and storage, (2) palatability tests on cooked dehydrated snap beans, carrots and sweet potatoes, (3) keeping quality of dehydrated vegetables (sweet potatoes, greens, snap beans) and (4) the nutritive value of home-dehydrated vegetables (sweet potatoes, turnip greens, snap beans). In general, it is concluded that many foods can be dried in simple apparatus to form a palatable product.

594. Beckley, V. A. Notley, V. E. Biochem.J., 1941, 35, 1396.

THE ASCORBIC ACID CONTENT OF DRIED VEGETABLES. Preliminary experiments to determine the ascorbic acid contents of fresh and dried (in the sun and artificially) cowpea leaves and the effect of time and temperature of drying on the ascorbic acid content of kale did not give satisfactory results. Further experiments were then made, using different types of drier, in which the ascorbic acid content and palatability of dried cabbage, cauliflower, green beans, carrots, and potatoes were investigated. Procedure used in preparing and drying the different vegetables is investigated. Procedure used in preparing and drying the different vegetables is described. It was found that potatoes and cauliflowers should be blanched before drying, while carrots, green beans and cabbages should be dried without previous blanching. (See also Vol. 13, No. 1232).

595. Crang, A. Jones, M., Jones, D.P. and Sturdy, M.

Rep. agric. hort. Res. Sta.

Long Ashton, Bristol, 1942, p. 129.

A COMPARISON OF THE ASCORBIC ACID CONTENT OF STORED PEAS, BEANS AND PARSLEY DRIED BY VARIOUS DOMESTIC METHODS. Preliminary experiments were made to determine the effect of various methods of drying vegetables under domestic conditions on the vitamin C content and cooking qualities of the stored product. Results showed that (1) peas dried by heating contained more vitamin C than peas dried in air, (2) dried beans were less satisfactory than beans stored in salt, but in both cases the beans cooked after storage contained little vitamin C, (3) different methods of blanching had varying effects on the dried product, (4) the method of covering was an important factor in retaining vitamin C and (5) 2 methods of drying parsley gave good results, but loss of vitamin C was high during storage in jars that were not airtight.

596. Cruess, W. V. Fruit Prod.J., 1942, 22, 69 and 111; 1943, 22, 136 and 171.
THE NUTRITIVE VALUE OF DRIED FRUITS AND VEGETABLES. Discusses the general composition of dried fruits and vegetables and their value in the human diet and deals with losses of vitamins which may occur during dehydration.
597. Cruess, W. V. and Joslyn, M. A. Proc. Inst. Food Tech., 1942, 3, 99. Chem. Abstr., 1943, 37, 961. Food Industr., 1943, 15 (No. 2), 120 (Abstr.).
SIGNIFICANCE OF ENZYME REACTION TO DEHYDRATION OF VEGETABLES. Studies were made of the effect of extent of inactivation of catalase and peroxidase on retention of flavour in dehydrated vegetables, with a view to establishing a quick reliable test for adequacy of scalding. Extracts of soaked, dried tissues were found to give more consistent results in testing for catalase or peroxidase activity than phosphate buffer extracts. Investigations of the influence of blanching temperature on catalase and peroxidase activity in cabbage, carrots, spinach, potatoes and onions showed that, although the catalase test will differentiate between unblanched and blanched dehydrated vegetables, the catalase apparently is inactivated at too low a temperature for flavour retention and is thus not a satisfactory test of adequacy of the blanch. Of the peroxidase test reagents, the guaiacol and benzidine reactions were least affected by drying procedure and pyrogallol, 4-napthol and gum guaiacum were most affected. Of the vegetables tested after drying, only potatoes showed phenolase activity. It is considered that the greatest loss of vitamin C during dehydration of vegetables occurs through non-enzymic catalysis, but that oxidation of carotene in various unblanched dehydrated vegetables is catalyzed by an enzyme system.
598. Davis, M. B. and MacArthur, M. Food in Canada, 1943, 3 (No. 5), 11.
FOOD VALUE AND KEEPING QUALITY OF DEHYDRATED VEGETABLES. The food values of dehydrated vegetables, as judged by the vitamin content immediately after processing, were found to be satisfactory. Determinations were made of carotene, vitamin C and vitamin B₁. Storage trials with dehydrated carrots, turnips, cabbage and potatoes at temperatures of 100°, 80°, 60°, and 30° F (37.78°, 26.67°, 18.33°, and 0°C) in atmosphere of air, carbon dioxide and nitrogen are reported, and vitamin retention and estimated longevity are tabulated. Preliminary results with beets, onions and parsnips are also given.

599. Diller, H. Vorratspflege u. Lebensmittelforsch.,
1941, 4, 389. Chem. Zbl., 1942, 1, 429. Chem.
Abstr., 1943, 37, 2479.

INFLUENCE OF THE DRYING METHOD ON THE CAROTENE CONTENT OF
DRIED VEGETABLES (transl. title). Blanching before drying
and cutting into small pieces both increased the loss of
carotene from vegetables; the greatest loss occurred if
the vegetables were blanched after chopping. Drying at a
temperature of 105°C, without sufficient circulation of air,
caused the greatest loss of carotene; at 50°C the loss was
somewhat less. Vacuum drying caused more loss than was
expected. Drying in a current of air heated to 85°C was
found to be the most practical method. The largest amount
of carotene was retained in vegetables dried at a low
temperature without blanching.

600. Heiss, R. and Vorratspflege u. Lebensmittelforsch.,
Wolf, J. 1941, 4, 141. Bull. int. Inst. Refrig.,
1941, 22, 246 (Title only) and 251. Chem.
Zbl., 1941, 11, 3255. Chem. Abstr., 1944,
38, 2134.

ÜBER DIE QUALITÄTSVERBESSERUNG UND -ERHALTUNG VON
TROCKENGEMÜSE. A report to the research service conference
on drying technique, held in Berlin on December 12th and
13th, 1940. Using an experimental belt drier, the
"Favorit" drier with an intermediate heater and an
electrically-heated vacuum drier, studies were made of the
influence of the drying process on vitamin content, odour,
flavour and colour and swelling ability of dried vegetables.
Results showed that significant losses of vitamin C may
occur during preparation and drying of vegetables, and also
during storage and cooking, the chief losses taking place
during treatments preliminary to dehydration and during
storage of the dried material, losses in storage being
minimized by storing at low temperatures (0° or -18°C).
The greatest loss in quality (vitamin C, swelling ability,
palatability and appearance) occurred during storage, other
causes of deterioration being the initial quality of the
product, preliminary treatment and method of drying.
Improvements can be made in various stages of the drying
process. The influence of pressing procedures on the
cooking quality of dried vegetables was also examined.

101. Kanitz, H. R. Z. Untersuch. Lebensmitt., 1941, 82, 430.
Chem. Zbl. 1942, 1, 1318. Chem. Abstr., 1943,
37, 2837.
DER EINFLUSS DER IONENSTÄRKE IM KUCHENWASSER AUF DEN BIOLOGISCHEN
WERT VON TROCKENMISCH. (VITAMIN C UND SEINE NUTZGESAMEN
EIGENSCHAFTEN.) The importance of the ions present in the water during
blanching, cooking and steaming on the biological value of dried
vegetables is emphasized. The use of alkaline water or water
hardened by the presence of carbonate was particularly destructive
of vitamin C and related substances during preparation of dried
vegetables. Adjusting the hardness of the cooking water by the
"hydro-food protecting" process improved the quality of dried
vegetables, 1/3 of the vitamin C content being retained in the case of
dried beans.
102. Kyzlink, V., Brozkova, S. Chem. Obz. 1941, 16, 81 and 104. Chem. Zbl.
1942, 1, 1949. Chem. Abstr. 1943, 37, 5797.
INFLUENCE OF DRYING ON THE QUALITY OF VEGETABLES. (transl. title.)
Cabbage, carrots, onions, celery, etc. were dried by the usual
commercial procedures of 50° to 55°C and also by cooler air (40°C)
which had been dried by sharp cooling. The experiments were carried
out in apparatus specially constructed for the purpose. Reliability
tests and analyses, including determinations of vitamin C, indicated
that (1) the composition of vegetables dried with cooler air did not
differ significantly from those dried in a warm air current by a
satisfactory procedure (too high temperature influenced protein
digestibility unfavourably, blanching too long decreased the content
of soluble solids), (2) drying in cooler air resulted in unusually
satisfactory swelling capacity, odour, flavour and appearance,
(3) the vitamin C content was reduced on drying, the lower tempera-
ture without pre-cooking being more satisfactory in this respect
than the usual commercial method using heat, and (4) in general, the
cold drying process improves many properties of the vegetables and
was easier and safer to carry out.
103. Mathiesen, E., Jacobsen, F., Tidsskr. Hesi Bery., 1940, 30, 18. Chem.
Kvalheim, E. Abstr., 1940, 34, 6378.
VITAMIN C IN DRIED VEGETABLES (transl. title). Vitamin C was deter-
mined chemically (Willman's titration method) and biologically in
vegetable powders of Norwegian and foreign origin. From 1 to 60% of
the original ascorbic acid was retained in the dried vegetables.
Norwegian vegetable powders, carefully dried at a temperature not
above 70°C, contained 50 to 85% of the original vitamin C content,
but were practically devoid of vitamin C after 1 year's storage in
the laboratory. Experiments with vegetable powders in only prepared
by the same method showed that there was a rapid fall in vitamin C
content after the first month, the decrease being later rapid during
further storage.

604. Mathiesen, E., Tidsskr.Kemi, Bergv.Met., 1941, 1, 91.
 Jakobsen, F., Solvig, K. Chem. Abstr., 1941, 35, 8136.
VITAMIN C IN DRIED VEGETABLES. II. EFFECT OF STORAGE AND OXIDATION
 (transl.title). The behaviour of vitamin C in dried vegetables
 stored under different conditions was studied. Samples stored in
 vacuum showed no change in vitamin C content after 7 months.
 Samples stored in the original packing material and in wax-sealed
 glass tubes showed an initial oxidation of ascorbic acid into dehy-
 droascorbic acid, which was further oxidized to biologically
 inactive compounds. Simultaneously the ascorbic acid was oxidized.
 After 6 months the vitamin C content was reduced to 80%. In
 biological determination of vitamin C in dried vegetables, the
 calculated daily amounts of vegetables for feeding must be based on
 a chemical titration of ascorbic and dehydroascorbic acids, as con-
 siderable amounts of vitamin C are oxidized rapidly during soaking
 of the powders in water.
605. Mathiesen, E., Tidsskr.Kemi, Bergv.Met., 1941, 1, 94. Chem.
 Jakobsen, F., Solvig, K. Abstr., 1941, 35, 8136.
VITAMIN C IN DRIED VEGETABLES. III. OXIDATION IN SUSPENSIONS AND
EXTRACTS OF POWDERS (transl.title). During soaking of dried
 vegetables (parsley and green cabbage) in water for culinary
 purposes, ascorbic acid was rapidly oxidized to dehydroascorbic acid
 and further oxidized. The rate of destruction varied with the kind
 of vegetable, parsley showing greater stability. A stabilization of
 vitamin C by citric acid was possible. By heating dried parsley in
 vacuum at a temperature of 90°C for 15 minutes, the stability of
 vitamin C was increased.
606. Mrak, E. M. Fruit Prod.J., 1941, 21, 13.
RETENTION OF VITAMINS BY DRIED FRUITS AND VEGETABLES. Factors which
 affect the quality of dried fruits and vegetables are considered
 briefly and the effect of treatments involved in dehydration on
 retention of vitamins by vegetables and fruits is dealt with. It is
 concluded that (1) steam-blanching tends to preserve vitamins A, B₁
 and C in dried vegetables, (2) sulphuring preserves vitamins A and C
 in dried fruits, has no effect on riboflavin, but tends to destroy
 vitamin B₁, (3) alkaline dips have no destructive effects on
 vitamins A, B₁ and riboflavin, (4) vitamins are retained better in
 products dried artificially than in those dried in the sun,
 (5) destruction of vitamins during storage depends on temperature
 and time of storage and moisture content of the fruit, higher
 temperatures and moisture contents causing an increase in loss of
 sulphur dioxide from fruit and thus an increase in the loss of
 vitamins A and C. Storage of fruit containing 12 to 14% moisture
 is recommended to retard loss of sulphur dioxide and hence the
 deterioration of vitamins A and C.

607. Reeve, R. M. Food Industr., 1942, 14(No. 12), 51.
FACTS OF VEGETABLE DEHYDRATION REVEALED BY MICROSCOPY. An illustrated article on the microscopic study of physical and chemical changes which may take place in vegetable tissue during dehydration. Microscopic observations show correlations with some of the analytical data on vitamin retention and help to explain loss of vitamins. Photomicrographs are reproduced showing carrot and potato cells when fresh, dried and reconstituted.
608. Reeve, R. M. Food Res., 1943, 8, 137.
MICROSCOPY OF THE OILS AND CAROTENE OILS IN DEHYDRATED CARROTS. The purpose of the work was to establish microscopic evidence of the relationship between carrot oils and carotene in both fresh and dehydrated tissues. Distribution of lipids and carotene, effects of cooking and dehydration treatments and means of increasing carotene retention are considered. Particular reference is made to factors concerned in the development of "off" odours and loss of carotene.
609. Allen, R. J. L., J. Soc. Chem. Ind. 66, 166-8, May 1947.
 Mapson, L. W.
SPRING OF VEGETABLES. Loss of ascorbic acid in drying carrots and potato in large scale factory plants.
610. Reeve, R. M. Food Res., 1943, 8, 146.
THE EFFECT OF BLANCHING ON DEHYDRATION OF VEGETABLES. Studies are reported on changes which occur on dehydration of beet slices, changes in cell content resulting from dehydration of parsnips, fresh and dehydrated tissues of rutabaga and the role of starch in dehydration of sweet potatoes. It was shown by chemical analysis and microscopic examination that blanching of certain vegetables before dehydration helps to preserve carotenoids (provitamin A) and inactivates enzymes, so that certain undesirable changes are minimized. There was also definite correlation between blanching and rate of carotene oxidation on storage of the dried product.
611. Sekhon, N. S. Indian J. med. Res., 1942, 30, 529. Nutrit. Abstr. Rev., 1943, 13, 167. Biol. Abstr., 1943, 17, 1655. Chem. Abstr., 1944, 38, 1809.
THE EFFECT OF DEHYDRATION AND RECONSTITUTION ON THE CAROTENE CONTENT OF CERTAIN VEGETABLES. Losses of carotene during dehydration and reconstitution of 12 vegetables were investigated. It was found that losses of carotene during dehydration are not serious (0 to 15%). The loss in a sample of potato subjected to blanching before drying was considerably greater. Reconstitution by soaking led to losses ranging from 0 to 20%. Preliminary tests suggest that the carotene in dehydrated vegetables was reasonably stable in storage.

612. Tressler, L. K.

New York St. agric. Exp. Sta. tech. Bull.
No. 262, 1942. Exp. Sta., Rec., 1942, 17, 450.
Canning Age, 1942, 23, 624.

NUTRITIVE VALUE OF DRIED AND DEHYDRATED FRUITS AND VEGETABLES.

Reviews the literature on the effect of commercial drying and dehydrating processes on the nutritive value of fruits and vegetables. General consideration is given to the commercial dehydration processes (sun drying and artificial dehydration), to specific processes used in manufacture of commercially important dried fruits and vegetables and to the nutritive value of these products. Supplementary tables present data on proximate constituent and mineral and vitamin contents of certain dried fruits and on vitamins (chiefly ascorbic acid) in certain dehydrated vegetables. Points out the necessity for inactivating the enzymes of vegetables by scalding or other means before dehydration. To retain vitamin C, dried vegetables should be stored in absence of air. Dehydrated fruits retain vitamins, particularly carotene and vitamin C, better than those which are sun-dried. Sulphuring of fruits aids in the retention of vitamin C, but causes almost complete destruction of the vitamin B₁ content.

613. Watts, V. M., Kik, M. C. Arkansas Agr. Exp. Stn. Bull. 469 20pp. (1947).

EFFECTS OF DEHYDRATION AND SUBSEQUENT STORAGE ON THE QUALITY AND VITAMIN CONTENT OF VEGETABLES.

Chem. Phys. Aspects

614. U.S. Dept. of Agric., Western Region,
Research Lab., Albany, California.

1. A.I.C. 31-1.
2. A.I.C. 31-IV.

1. Riced Potato.

2. Shredded Cabbage, Drying rates and nomographs.

615. Arsdel, W. E. van

Food Industr., 1944, 14 (No. 10). '43, (No. 11),
47 and (No. 12), 47.

TUNNEL DEHYDRATORS AND THEIR USE IN VEGETABLE DEHYDRATION. Deals with factors which govern the choice of a suitable dehydrator for vegetables with reference to form of product, type of vegetable, size of drying plant, time and flexibility of operation, moisture content of product, prevention of objectionable odours, disposal of waste, etc. Describes general features of tunnel dehydrators and various types of air-circulation in them. The physical and engineering bases of the operation of continuous dehydrators of the tunnel type are discussed. The chief conclusions are that (1) while there are marked differences in the initial rates of drying of different vegetables, the times required to reach the same final dryness are more nearly alike, (2) the greater the surface exposed to the drying air, and the more porous the layer on the tray, the more rapid will be the rate of drying, (3) if air is circulated across the trays, the drying rate is

highest at low densities of loading per square foot of tray area, (4) the drying rate increases as velocity of air flowing across the tray increases, (5) the higher the temperature and the greater the wet-bulb depression, the faster the drying rate will be, provided that case-hardening does not result, and (6) total drying time increases rapidly as final moisture content comes near to its equilibrium value. The operating characteristics of tunnel dehydrators are discussed. The temperature change along a tunnel is dealt with and a diagram shows air-temperature along counter-flow, parallel-flow and centre exhaust tunnels. The effects of (1) rate of tunnel loading, (2) specific differences between products, (3) increasing air flow through the tunnels, (4) increasing re-circulation of air, (5) variations in tray loading and (6) complications in practice are dealt with.

616. Arsdel, W. B. van Heat., Pip. Air-Condit., J. Sect. Amer. Soc.
Heat. Vent. Engrs., 1943, 15, 157 to 161.

SOME ENGINEERING PROBLEMS OF THE NEW VEGETABLE DEHYDRATION INDUSTRY. Essential specifications which should be considered in the design of a dehydration system are outlined. New data on vegetable dehydration, with charts showing the drying rates, are presented, with special reference to drying characteristics of potato, and the effects of drying conditions on quality. Drying curves are given for strip potato, illustrating the effects of separate variables. The important effect of wet bulb depression is well illustrated.

617. Arsdel, W. B. van Chem. Engg. Progr. 1, 1947.
DRYING: FALLING RATE PHASE: APPROXIMATE DIFFUSION CALCULATIONS.
See under Principles, Diffusion.

618. Christie, A.W., Matsumoto, K. Int. Amer. Soc. Heat & Vent. Engrs.
33, 381, 1927.

STUDY OF AIR VELOCITY AND TEMPERATURE IN VEGETABLE DEHYDRATION. 160°F. is highest safe temperature for carrots and peas. 180°F. for cabbage. Optimum air velocity 500 c. ft. per min. Higher velocities increase rate of drying but are inclined to injure the quality.

619. Cruess, W. V. Fruit Prod. J., 1943, 22, 356.
GENERAL PRINCIPLES OF DEHYDRATION. Discusses basic principles concerned in dehydration of vegetables, dealing with (1) the effect of moisture content on heat requirement for drying, and the functions of air in dehydration, (2) measurement of relative humidity and the effect of air velocity on rate of drying, (3) relation of relative humidity of the air to moisture content of the dried product, (4) effect of humidity on critical temperature, with reference to relative humidity and case hardening, constancy of wet-bulb temperature, recirculation of air, effect on rate of drying of (a) variety of vegetable, (b) tray load and (c) size and shape of pieces, and rate of removal of moisture at different stages of dehydration.

620. Eidt, C. C. Food in Canada, 1942, 2(No. 12), 17.
THE MECHANICS OF DEHYDRATION. Deals with reasons for and methods of using heat and humidity in dehydrating vegetables, with reference to the functions of air, heat and humidity, critical temperatures and the necessity for a large surface exposure.
621. Gane, R. J. Soc. Food & Agric. 1(2) 42-46. 1 Feb. 1950.
THE WATER RELATIONS OF SOME DRIED FRUITS, VEGETABLES AND PLANT PRODUCTS. The water contents of some dehydrated plant products have been determined in atmospheres of known humidity 0%-80%, usually at temperatures of 10°C, and also at 37°C, 60°C. and 80°C. for carrot and potato. The colloids and soluble constituents each play a part, the former having high, and solubles having low moisture content at low humidities. The humidity water content of soups etc. can be calculated from the ingredients. Results on some 30 materials are tabulated.
622. Ghilardi, F. Gen. civ., 1943, 120, 42(Abstr.).
LES PROCÉDES MODERNES DE DÉSHYDRATION DES FRUITS ET DES LÉGUMES.
 Summary of a paper presented at a meeting of the Association pour la Recherche des Economies et des Matieres de Remplacement at Orleans, on November 28th, 1942. Discusses the 3 forms in which water is present in fresh vegetables: (1) superficial water (resulting from rain or washing), easy to remove, (2) water of imbibition (contained in the vessels and mainly a constituent of the sap), more difficult to evaporate, and (3) water of constitution, forming part of the cell itself, which cannot be removed without alteration in the cell structure and producing an effect of caramelization. The use of tunnel, rotary and tray driers and exposure of vegetables to a rapid current of air are dealt with. Draws attention to improvements in driers used in France, especially those employed by the Etablissements Vernet. Suggests that methods of drying (1) at low temperatures, (2) by application of high frequency currents (diathermy) and (3) by means of infra-red rays should be studied.
623. Makower, B., Industr. Engng. Chem., 1943, 35, 193.
 Dehority, G. L.
EQUILIBRIUM MOISTURE CONTENT OF DEHYDRATED VEGETABLES. Experiments were carried out with dried carrots, cabbage, yams, spinach and white potatoes to determine their equilibrium moisture contents, by allowing them to attain equilibrium in air-free desiccators containing sulfuric acid solutions to control the relative humidity. Fresh vegetables were used for desorption measurements and dried vegetables for adsorption. Sorption isotherms for all vegetables were S-shaped and were characterized by an inflection point in the neighbourhood of 5% moisture content. Blanching of white potatoes was found to cause a decrease in the equilibrium moisture content, which was ascribed to a change in the physical state of the starch granules. Application of the sorption data to dehydration and packaging of vegetables is discussed.

624. Powers, R. T.A.S.H.V.E. 27, 241. 1921.
DRYING OF FRUITS AND VEGETABLES. Times, Temp., and R.H. given for peaches, pears, beans.
625. Reeve, R. M. Food Industr., 1942, 14(No. 12), 51.
FACTS OF VEGETABLE DEHYDRATION REVEALED BY MICROSCOPE. An illustrated article on the microscopic study of physical and chemical changes which may take place in vegetable tissues during dehydration. Microscopic observations show correlations with some of the analytical data on vitamin retention and help to explain loss of vitamins. Photomicrographs are reproduced showing carrot and potato cells when fresh, dried and reconstituted.
626. Reeve, R. M. Food Res., 1943, 8, 128.
A MICROSCOPIC STUDY OF THE PHYSICAL CHANGES IN CARROTS AND POTATOES DURING DEHYDRATION. Vegetable tissues were prepared for microscopic examination after different periods and methods of drying by a modified celloidin impregnation and embedding method, by means of which the dehydrated condition was preserved. Extent of shrinkage during dehydration and differences between blanched and unblanched dehydrated vegetables are described, using carrots and potatoes as types of vegetables with low and high starch content, respectively. Case hardening depended on rapidity of evaporation, cell contents and thickness of the slices or cubes prepared for drying. Blanching of potato caused starch gelation and the gelled starch sealed the dehydrated tissues. Incomplete gelation of starch resulted in lumpiness in the reconstituted product. Forced drying produced other undesirable effects. Steam-blanching of thin pieces of vegetable before dehydration resulted in a more uniform rate of evaporation and uniform starch gelation.
627. Singh, L., Lal, G. Indian Eng. 1941, 1, 308, Hort. Abstr., 1941, 11, 353.
DRYING OF VEGETABLES. An account is given of the general principles involved in drying vegetables, with details of procedure for drying potatoes and outlines of methods of drying onions, cauliflower, carrots and peas. Describes some experimental results obtained in investigations under the Fruit and Vegetable Preservation Scheme of the Punjab Government and Imperial Council of Agricultural Research.
628. Stewart, E. D. Food Inds. 4(15) 174-6, 1932.
DRYING FRUITS AND VEGETABLES WITH SUN OR HEATED AIR. Discussion of the thermal requirements for dehydrating various fruits. Drying rates. Comparison of costs: sun dried v.s. artificially dried.

Standards

629. Bingfield Food Industries 1941, 13, 6, p.81.
Summary of Bingfield Report prepared by the Bureau of Foreign and Domestic Commerce on present and proposed production of dried Vegetables. Federal Specifications for 7 Veg. commodities.

630. Anon. Food Industr., 1942, 14(No. 11), 4.
ARMY STANDARDS FOR DEHYDRATED FOODS. Gives specifications for packaging dried vegetables and for preparation, blanching, dehydration, quality standards and re-hydration of white and sweet potatoes, rutabagas and beets. See also 15. 1. 55. This J.
SEE ALSO UNDER "FOOD GENERAL" Nos. 14. 12-23.

POTATO

631. ---- Communication from National Asscn. of Potato Crisp Manufacturers 1951.
POTATO PUFF. PNEUMATIC DRYING. An oil free, pillow shaped delicacy, of toasted colour, produced from internally formed steam, resulting from rapid surface drying causes expansion. Process is worked out by the Western Reg. Exp. Lab. of U.S. Dept. of Agric., Albany. Drying and puffing is done in a vertical hot air stream moving at 2000 feet per minute or more, so that unpuffed pieces are kept in motion. Bulk is twice that of dehydrated wafers, 1 lb. = 56 c. in.
632. ---- Bureau of Agric. Chem. and Eng.
Report No. 170. 1950.
THE DEHYDRATION OF POTATOES.
633. ---- Sci. Lib., Sci. Mus., S. Kensington, Lond.,
Bibliogr. Ser. No. 519, 1940.
THE DRYING OF POTATOES. A bibliography of references to the literature. 95 Refs.
634. ---- Naamlooze Vennootschap W.A. Scholten's
Aardappelmeelfabrieken. B.P. 532, 247
(January 23rd, 1941). Brit. chem. physiol.
Abstr. B, III, 1941, p. 106.
A METHOD OF PRODUCING FOOD-STUFFS. Potatoes are comminuted, the juice is drained off and the residue is mixed with comminuted vegetable materials (waste sugar beet, with or without tops and leaves, green fodders, etc.). The product may then be dried for animal or human consumption.
635. Anon. Food Industr., 1943, 15(No. 3), 47.
HOW POTATO CHIPS ARE MADE. Describes the procedure used and operation of an Idaho plant which produces dehydrated potato shreds. The potatoes are inspected, washed, scalded to facilitate peeling, batch-peeled, inspected and trimmed, sliced, cooked and dried. If desired, the cooked potatoes can be extruded before drying. The hot dry material is cooled before packaging. Construction of the dehydrator is described. Temperature of the dehydrator tubes is controlled automatically.
636. Anon. Food Packer & Canning Age, 1943, 24, 588.
CONTINUOUS FRIER IN MAINE CANNERY. Describes and illustrates a new continuous tunnel dehydrator for potato strips, in which moisture

is removed in 2 stages, (1) quickly from a thin layer of material and (2) more slowly from a thicker layer. The potatoes are steam-peeled, trimmed and cut into strips; the strips are sprayed to wash off excess starch, steam-blanching, dehydrated and finally transferred to finishing bins. The dehydrator can also be used for diced potatoes and other tuber products.

637. Barker, A. Food, 1943, 12, 16.

POTATO FLOUR. PROCESSES IN POTATO FLOURIFICATION. Describes 2 methods of preparing cooked potato flour from raw potatoes by (1) steam-cooking, mashing, drying the mash on a cylindrical steam-heater (roller drier), scraping off in flake form and milling and (2) boiling or steaming and mixing with water to a "soup", which is then spray-dried. Uncooked potato flour is prepared in the form of chips, which are dried in a tunnel at a temperature of 200° to 250°F (93.3° to 110°C) and the dried product is milled to produce a flour. Results of analyses of both types of flour are given and their uses by the bakery trade are indicated. Potato flour can also be used as a thickening agent for soups, sauces, pastes, etc. Addition of the flour to bread is stated to improve the keeping quality.

638. Barker, J., Burton, W. G., U.K. Progress Report Oct. 1943, VI part 8. Gane, P. pp. 1-9.

MACHED POTATO POWDER. I. PREPARATION AND METHOD OF PRODUCTION. The preparation and process of drying (Roller dryer). The effect of moisture on storage life.

639. Black, H. G. Fruit Prod. J., 1943, 22, 370. Food Packer & Canning Age, 1943, 24, 529. Canner, 1943, 97 (No. 11), 12.

EFFECT OF STORAGE ON IRISH POTATOES USED FOR DEHYDRATION. Studies were made of the effect of storage on moisture content after blanching and dehydrator capacity. Moisture content of the blanched product was found to increase with the length of time stored; as the moisture content increased, the capacity obtained under like conditions decreased. Stored potatoes were more sensitive to heat than new potatoes; as the age of the potato increased, the tendency to scorch also increased. Results indicated that potatoes can be dehydrated successfully if stored under proper conditions for a period of at least 6 months from the date of harvest.

640. Bowen, W. S. Food Industries, 3, 380-3 Sept. 1931.

SPRAY DRYING IDAHO'S SURPLUS POTATOES.

Cooler: 72' x 4' 100#/min. continuous steam from 100 HP oil fired boiler. Pulp diluted with water in mixer - live steam in storage tank. Spray machines - 5. Alum. disks at 8,000 - 10,000 R.M. Atomized to form mist. Hot air blast. Leaving tower at 107,000 c.ft/min.

641. Brown, A. H., Trans. Amer. Soc. Mech. Engrs. 65, 837-842,
Kilpatrick, P. W. 1943.
DRYING CHARACTERISTICS OF VEGETABLES - DICED POTATOES.
642. Burton, W. G. J. S. C. I. 63, 213, 1944.
MASHED POTATO POWDER. II. SPRAY DRYING METHOD.
643. Burton, L. V. Food Industr., 1943, 15(No. 11), 59.
DEHYDRATED LISTS NEW TECHNOLOGY. Describes and illustrates the operation of the Eimco dehydration plant in Idaho, now handling mainly potatoes but also some onions. After washing, the potatoes are steam-cooked, the principal feature of the system being the use of conveyor legs that trap steam inside it, then lye-peeled, washed and, after inspection, trimming and cutting, the diced potatoes are spread on a screen-wire conveyor belt and blanched in live steam. A cold water wash removes surface starch and the potatoes are then loaded on trays and dried for 8 to 10 hours in a counter-current air flow at a temperature of 140° to 150°F (32.7° to 65.5°C) on the dry end. The drying tunnels are described. After inspection, the product is packaged in fibreboard containers, placed in wooden boxes.
644. Caldwell, J. S., Canner. 107(2) 13. (3) 30, 1948.
Culpepper, C. W.
DEHYDRATION OF SWEET POTATOES. I and II. General consideration, preparation, drying conditions, storage results, and a study of varieties are included.
645. Caldwell, J. S., Leonard, F.M., Canner, 1948, 17(No. 3), 30, (No. 4), 14 and
Culpepper, C. W. (No. 5), 15.
VARIETY AND PLACE OF PRODUCTION AS FACTORS IN DETERMINING SUITABILITY FOR DEHYDRATION IN WHITE POTATOES. Reports a study of the comparative suitability for dehydration purposes of the more important varieties of potato grown commercially and of some recent introductions. Methods of preparation of the material, peeling and pre-cooking, drying temperature, the dehydrator used, storage of dried material, preparation for and factors in judging and grading colour are dealt with. Relationships between specific gravity of fresh, whole potato and (1) texture or consistency and flavour of the cooked rice product made from dehydrated material, (2) amount of water absorbed in soaking and cooking and (3) grade of the cooked dehydrated product were investigated. Quality in relation to variety and place of growth and the effect of rate of application of fertilizer on quality are considered. Losses in peeling and trimming and yield and colour of the dry product are also discussed.

646. Cronmeyer, H. Vorratspflege u. Lebensmittelforschung, 1941, 4, 171. Bull. Int. Inst. Refrig., 1941, 22, 246 (Title only).

DIE TROCKNUNG DER SPEISEKARTOFFELN IN SCHEIBEN. A report to the research service conference on drying technique, held in Berlin on December 12th and 13th, 1940. Deals with the dehydration of sliced potatoes in Germany, particularly work undertaken for the German Ministry of Food and High Command of the Army. Discusses the properties of dried potatoes slices, with reference to selection of suitable varieties of potato, difficulties caused by blackening of peeled, cut potatoes, the importance of retention of vitamin C during drying and peeling, blanching and drying stages in the process of production of dried potatoes, as well as utilization of the residual peel.

647. Cruess, W.V., Friar, H. Canner, 1943, 97 (No. 14), 14.

NOTES ON DEHYDRATION OF POTATOES. Discusses difficulties which have arisen in the dehydration of potatoes. Reddening and yellowing of the colour may be due to (1) a high finishing temperature or prolonged heating at the finishing temperature, (2) holding new potatoes at low drying temperatures and high relative humidity in the tunnels, or (3) insufficient washing after lye peeling. The presence of chalky pieces usually indicated over-blanching, but in one case it appeared to be caused, in part at least, by bacteria. Souring of blanched potato by bacterial action could be eliminated by placing fewer cars in the tunnels, thus hastening initial drying of the potatoes, and by not overloading the trays. Sulphiting before dehydration was found to be beneficial in retaining colour. The use of bin drying is theoretically useful, but it involves extra handling, some breakage in unloading the bins and more supervision at the plants.

648. Doty, D.M., Bergdell, M.S., U.S.Q.M. Food & Container
Greene, L., Lewis, W.R., Ellis, N.K. Institute. Committee on
Food Res. Nov. 1945-Dec. 1947.

DISCOLORATION OF WHITE POTATOES DURING DEHYDRATION. Investigation into the causes. e.g. variety, degree of maturity and storage, and the compounds responsible for discoloration. Methods and results are given. Tables, graphs and bibliography.

649. Eidt, C. C. Food in Canada, 1943, 3 (No. 2), 14.

CONSTRUCTION AND OPERATION OF DEHYDRATORS. Deals with the engineering principles involved in dehydration, with reference to dehydrator tunnels, floors, walls and doors and the mechanical equipment required in a dehydrator which is to handle 30 tons of raw potatoes every 24 hours (giving details of the primary end, the secondary or finishing end and control and recording equipment) and operation of a dehydrator.

650. Forberg, D. A. Heat., Pip. Air-Condit., J. Sect. Amer. Soc. Heat. Vent. Engrs, 1943, 15, 439.
TUNNEL DEHYDRATION (VEGETABLE DRYING). Outlines the pre-treatment of white potatoes for drying and the actual drying process, and gives a description of types of tunnel dehydrator, their accessory equipment and method of operation.
651. Friar, H. F. Fruit Prod. J., 1943, 22, 339.
A PROBLEM IN DEHYDRATION OF NEW POTATOES. Reports a series of experiments to determine the cause of yellowing and darkening of new potatoes during drying. The effects of different methods of preparation, varying temperatures and humidities and of treatments after blanching with citric acid, salt and potassium metabisulphate solutions were studied. The following procedure was satisfactory: the potatoes were lye-peeled in a 1% solution, prepared Julienne style and blanched for 4 minutes and 40 seconds at a temperature of 212° to 214°F (100° to 101°C). Dehydration was accomplished in 2 tunnels: in the first the temperature was 140° to 142°F (71.11° to 72.22°C), 90° to 92°F (32.22° to 33.33°C), wet bulb, the cars being held there for 8 hours, then moved to the second tunnel at 125°F (51.67°C), 80°F (26.67°C), wet bulb, for 4 1/2 hours. It is suggested that the finishing temperature might be safely increased to 135° to 140°F (57.22° to 60°C).
652. Greene, J.W., Conrad, E.M., U.S.P. 2,400,431, 8/12/1949. Chem. Abstr. Rohrman, F.A. 44(5), 2141, 1950.
DEHYDRATING PROCESS FOR STARCHY VEGETABLES AND FRUITS HAVING A PEEL. Potatoes are cooked (unpeeled), slowly frozen, thawed, suspended in salt solution, and screened to remove peel before dehydration. The thawing part of the process may be a surface thawing where interior remains frozen, and peel removed by washing.
653. Greene, J.W., Chem. Eng. Progr. 44, 547-52, July 1948. Rohrman, F.A., et al.
DEVELOPMENT OF A POTATO GRANULE PROCESS. Outline of the development of a potato granule drying process in which combination pneumatic conveying, drying, and rotary drying were employed. "This paper presents the first significant data on drying combined with pneumatic conveying". Tables of experimental data are given. Success depends upon the cooking treatment etc. and the final drying by pneumatic means to prevent abrasion of the granules.
654. Ingram, M., Food Manuf., 1949, 24, 297-300. Rousset-Hall, O. de
DRIED MASHED POTATO BLOCKS. Blocks of dried mashed potato, used by the Armed Forces during the war (especially for emergency and parachute rations), can be prepared from commercially mashed potato powder and fat with or without the addition of milk powder or salt. These blocks, which may be made by compression or, more simply by

moulding, and which, on reconstitution with hot H₂O give rise to mashed potato, have a satisfactory storage life at normal temp. which, however, is reduced to a few weeks under warm conditions, especially if wrapped in fat-permeable materials.

655. Ingram, M., F.I.B. Memoir Aug. 1949.
Rousset-Hall, O. de
DRIED MASHED POTATO BLOCKS. Satisfactory blocks for reconstitution only if fat is added. Milk and salt if desired. Storage life is according to temperature.
656. Jirak, L. W. Z. Spirit Industr., 1938, 61, 217. Brit. chem. physiol. Abstr. B, 1938, p. 1224. Chem. Abstr., 1939, 33, 1438.
DEHYDRATION OF GROUND POTATOES BY MEANS OF A HYDRAULIC FILTER PRESS (Transl. title). Favourable results were obtained with the hydraulic filter press patented by J. Hoffmann and Brigger (Austrian Patent 152,820 (March 10th, 1938) for separation of potato sap from pulp. The use of the apparatus in preparation of potato flakes and products and recovery of sap by-products is discussed critically.
657. Jones, C.R., Greer, E.N. B.P. 537,869 (July 1st, 1941). Brit. chem. physiol. Abstr. B. III, 1941, p. 242.
IMPROVEMENTS IN OR RELATING TO THE REDUCTION OF POTATOES AND OTHER STARCH-CONTAINING VEGETABLES TO DRY POWDER. Describes a process which consists in cooking the potatoes (or other vegetables), breaking up the mass, submitting it to partial drying and disintegrating the vegetable material in a hammer mill, so as to produce a product free from large particles and with the cell structure undamaged and which, subsequently, may be reconstituted with hot water or other suitable liquid to form a mash of normal flavour, texture and consistency.
658. Jones, C.R., Greer, E.N. U.K. Progress Rept. Oct. 1943, VI part 6. pp. 1-3.
MASHED POTATO POWDER. II HAMMER MILL PROCESS. Use of hammer mill after roller drying and then subsequent drying was found to be beneficial to ultimate quality.
659. Kroner, W. Vorratspflege u. Lebensmittelforsch., 1941, 4, 176, Z. Spirit Industr., 1941, 64, 67. Chem. Zbl., 1941 I, 3454. Bull. int. Inst. Refrig., 1941, 22, 246 (Title only).
PHYSIKALISCHE UND CHEMISCHE FRAGEN BEI DER HERSTELLUNG VON TROCKEN-SPERSEKARTOFFELN. A report to the research service conference on drying technique, held in Berlin on December 15th and 16th, 1940. Reviews some of the physical and chemical problems which may arise in the manufacture of dehydrated potatoes for use as human food, with reference to the selection of suitable raw material, the blanching operation, swelling capacity and vitamin content of the product and its preparation for serving.

660. Kröner, W., Lamel, H. Vorratspflege u. Lebensmittelforsch., 1939, 2, 465. Nutrit. Abstr. Rev., 1940, 9, 548.
FÜR KENNTHNIS DES BLANCHIERPROZESSES BEI DER HERSTELLUNG VON TROCKEN-
 SPEISEKARTOFFELN. Reports experiments on the effect of blanching
 treatment (heating for 2 to 5 minutes in aqueous sodium chloride
 solution at a temperature of 95° to 100°), to prevent darkening in
 colour of dried sliced potatoes, on the nutritive losses (in protein,
 organic substances and minerals), with reference to the effect of
 temperature of bath, concentration of sodium chloride, duration of
 process, proportion of water used and shape and size of slices.
 Losses up to 50% of proteins and minerals were experienced.
661. Lamel, H., Kröner, W. Vorratspflege u. Lebensmittelforsch., 1940,
 3, 441. Chem. Zbl., 1941, 1, 2191.
ORTENAUSWAHL BEI DER HERSTELLUNG VON TROCKENSPEISEKARTOFFELN.
 Factors which are important in the selection of varieties of potato
 for dehydration for human food purposes are discussed, and results of
 the preliminary survey of suitable German varieties are tabulated.
662. Lampe, B. Z. Spiritindustr., 1938, 61, 324. Brit. chem.
 physiol. Abstr. B, 1938, p. 1494. Chem. Abstr.,
 1939, 33, 5588.
SPENT-WASH DRYING: [POTATO] WASH FLAKES (transl. title). On the
 laboratory scale, it is possible to mix fresh spent wash (without
 separation into liquid and residue fractions) (100 parts) with
 potato flakes (6 parts) and dry on a drum drier to produce wash
 flakes containing 7% water and 15% crude protein.
663. Lawrence, G.N., BIOS Report No. 186.
 Scott, A.W., Barnell, H.R.
DEHYDRATED POTATOES AND VEGETABLES IN GERMANY. pp. 1-85 description
 of process. About 24 pp. of diagrammatic data. Diagrams of Tray
 Type Dryer. Puttner Spiral Band Tray Dryer. Imperial Dryer.
664. Lease, E.J., Mitchell, J.H. S. Carolina agric. Exp. Sta. Bull. No. 329,
 1940. Exp. Sta. Rec., 1940, 83, 806.
BIOCHEMICAL AND NUTRITIONAL STUDIES OF DEHYDRATED SWEET POTATO. It
 was found that sweet potato flour contained more than 3 times as much
 carotene as raw sweet potatoes (with a moisture content of 88%).
 Feeding experiments with dairy cows and laying hens are reported, in
 which sweet potato meal was used as a source of carotene and vitamin
 A. Suggestions are made with regard to the use of sweet potato flour
 in recipes (devised by E. Mishler) for human food. Analyses of
 carotene in the flour and in baked products prepared from it are
 included.
665. Mapson Electr. World 126, 116. 11/1946.
INFRA-RED DRYING. see under Infra Red.

666. Moran, T., Jones, C. R., J. Soc. Chem. Ind., Lond., 1942, 12, 163.
Webb, F. C.

THE REFINING OF LARPLY CHAFED OR SCORCHED DRIED POTATO SLICES.

Describes a method which has been developed for the separation of scorched material from potato slices dried in rotary drum driers at high temperatures. It consists of kitting the slices, followed by differential sieving and aspiration. In this way 70% of the total product is obtained in a refined form, suitable for use in different types of food as a substitute for wheat or other cereal flour.

667. Potato Corp. of Idaho. F.P. 26, 474 (September 1941, 1940).

TREATMENT OF POTATOES TO PRODUCE DRIED MASHED POTATO.

Skinmed potatoes are sliced and immersed in water (pH about 10), the temperature of which is raised gradually to boiling-point, after which the potato slices are removed and allowed to dry. The product is cooled, chopped into smaller pieces if necessary, and then extruded to form strings or strips which are dried on a conveyor in air at a temperature about 70°C. The process ensures that the potatoes are cooked without material separation of starch grains and the dried potato, on stirring with boiling water or milk, gives a product claimed to be similar to mashed potato made in the usual way.

668. Pyke, W. E. and others. U.S.C.M. Food & Container Institute. Cited on Food Research Final Report June 1947.

STUDIES OF FACTORS AFFECTING STABILITY AND QUALITY OF DEHYDRATED POTATOES. Assembly of information during project. The Maillard reaction between sugar and amino-acids is developed. Bibliography.

669. Rivoche, E. J. 1. B.P. 601, 151.
2. B.P. 601, 152. 16.9.1939. B.III. Nov. 1948.
1394.

POTATOES. 1. Cook under pressure, without increasing water content, partially dry by vacuum or with current of hot air to a damp powder 48-60% water. Then dry by conventional method. 2. Cooked washed potatoes are frozen, thawed, and water removed by centrifuging prior to final drying.

670. Schmalfass, H., Schmalfass, H., Vorratssilage u. Lebensmittel-
Sjauken, L. forsch. 1940, 3, 206.

DAS DUNKELN DER KARTOFFELN, ZUCHTUNG UND VERARBEITUNG NICHTDUNKELNDER KARTOFFELN. IV. DER EINFLUSS DES WASSERGEHALTS AUF DAS DUNKELN DER KARTOFFELN. An investigation was made to determine the best method for drying potatoes so that they do not darken. A non-darkening variety should be selected and drying should be as rapid as possible, i.e. at a relatively high temperature. The optimum final water content differs for each variety. Small-scale drying tests were made and results are tabulated.

671. Stamberg, O. E., Food Industr., 1943, 15(No.9), 78.
 Beresford, H.
POTATOES BAKED, THEN DEHYDRATED TO AVOID LOSS OF PRODUCT. Gives a brief account of the method of processing used in dehydrating baked potatoes. Results showed that baking before dehydrating increased the yield, eliminated waste and solved a waste disposal problem, since the peels are dried for use as a feeding-stuff. The potatoes are produced in the form of shreds, which, if desired, may be ground to a flour.
672. Varinois, M. Bull.Ass.Chim.56, 631, 1939. Br.Chem.Phys.
 Abstr.B. 1286. 1939 Chem.Abstr.34, 585, 1940.
DRYING OF POTATOES (transl. title). A description of the potato drying industry is given. Advantages of drying for storage, transport and industrial distillery purposes; and the food value of the dried product are reviewed.
673. Wager, H.L., Jenkins, E.G., Food Manufacturer 20(2) 204-206.
 Brightwell, S.T.P., Aug.1945(1) 20(9) 321-5 Sept.1945(2)
 Allan, R.J.L., Mapson, L.W.
THE DRYING OF POTATOES. (1) Process for dried potato strips. Conditions for scalding liquor, and for various varieties of potato and loss of soluble matter. (2) Retention of Ascorbic Acid by variations in process. (3) 20(10) 357-371 Oct.'45. The Dried Product. Effect of sulphite on culinary quality and similar considerations. A comprehensive series of papers. 68 References.
674. Western Region Res.Laby. A.I.C. 31-1.
 U.S. Dept. of Agric. Albany,
 Calif.
POTATO. Drying Rates. Nomographs.
675. Williams, A. E. (Engineer, 11 May, 1945, 179, 374-6).
DEHYDRATION OF POTATOES. The drying equipment is usually in the form of a tunnel dryer. The pulp passes down two tunnels counter-current to hot air at 180°F. and then up a centre tunnel at 180°F. The air is heated usually by steam. A normal plant evaporates about 1000 lb/ water/hr. for a steam consumption of 2400 lb. at 60 lb./sq.in. Auxiliary machinery (fans etc.) require about 9 Kw. After sifting, the potato powder is dried to 6-7% moisture by further passage through a tunnel kiln or by spray drying.

676. Williams, A. E. Food Tr. Rev., 6-7. 12. 1947.
DEHYDRATION OF POTATOES. Present methods described. Loss of ascorbic acid shown to be little greater than that for boiled potatoes.

YEAST

677. ——— A.D. Little Inc. p. 3-4. June 1949.
Facts for Industry 2(3) March 1949.
DRYING TRIMLES THE COST OF PRODUCTION. Central drying plants are necessary. Smaller breweries produce quantities too small to justify a drying plant.
678. Campbell, W. G., B.I.O.S. Report No. 5, p. 2.
Bunker, H. J.
REPORT ON VISIT TO KELLISTOFF FABRIK A.S. NEAR PEDERESBORG. Drum filters, - autolysed and spray dried in large circular rooms. Yeast cream at 70°C needs hot air at 100°C, and removed and packed. Thus a powder is obtained, and not floke as in roller drying. No other details.
679. Farrall, A. W. Food Ind. 3, 513-4, (1931).
POWDERED YEAST PREPARED BY SPRAY DRYING. Atomized at 10-15% solids. Dryer of Gray-Jensen type mfd. by Douthitt Eng. Co. (Chicago, Illinois) Capacity 215-250+ pounds/hr., uses 15,000 ft.³ air/min. Chamber 10' dia. Cold air heated to 225-250°F. by Acrolin coils. Leaves first chamber 150°F., 50-60% saturated. Leaves second chamber wet. at 100-125°F. Liquid pressure 2000-4000 lbs. at atomizer. Material used. Allihnery and heavy galv. iron. Multi-stage type liquid heater to keep liquid in collector at correct temp.
680. Oxnam, J. S. B.I.O.S. Report No. 1559.
STARCH ADHESIVES. p. 1. Twin roller dryers (no name) 250 K.g. per hour of dry yeast from each duplex dryer. From 85% to 95% moisture at 40 p.s.i. steam pressure. Ironing stand. Jacketed mixer between the rollers. Condensate from rollers passes through the jacket of the mixer before discharge. Each roller has a series of individually adjusted doctor knives, staggered, with 1" overlap. Material is at 220°F. on the roll. 4 r.p.m., variable.
681. Stubbs, A., of Kestners. Food. 7. 1948, 17, 202 and 213-5.
DRY ACTIVE YEAST. Spray drying and yeast activity. Time in contact with hot gas. Moisture content of dry product.

ADDENDUM

682. Bureau of Agric.Chem.and Engg.A.C.E.
Rept.No.163. 1950.
THE DRYING OF VEGETABLES.
683. Food Machinery Assn. 1950.
BRITISH FOOD MACHINERY. 108 pp. List of members. Products and Services. Food machinery illustrated.
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SOURCES, DISTRIBUTION AND PRODUCTION OF PECTIN. Includes a brief description of the drying of apple pomace and pectin. For pomace, direct heating with flame gases, or contact with steam pipes are the two main methods, but the temperature should be as low as possible. For pectin evaporation and spray drying are usual.
685. Chilpepper, C.W., Moor, H.E. U.S.Dept.Agric.Tech.Bull.842.1937.
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686. Citting, C.L., Bannerman, A. Food Investigation Leaflet No.14.
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A TEN STONE CONTROLLED FISH SMOKING KILN.
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31 pp. March 1947.
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688. Kestner B.P.630,153.1947.
PREPARATION OF SOLUBLE COFFEE. The ground unroasted coffee beans are solvent extracted and water extracted, the combined extracts are concentrated, spray dried and given a heat treatment which develops the aromatic constituents to give an infusion comparable with that of fresh ground roast coffee infusion.
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PRINCIPLES OF FRUIT PRESERVATION. Chap.14. pp. 180-187. Principles of dehydration. 39 Refs.
691. Trevelyan, D. E. Agric.Exp.Stn.N.Y.Tech.Bull.No.282.
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DRYED FRUITS AND VEGETABLES AS A FOOD. Nutritive value of dried fruits and vegetables. Bibliography pp. 37-44.

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Hannah Dairy Rsh. Inst. 1951.
DRIED MILK. A brief description of the methods of preparation of dried milk powder and of the way it should be stored.
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DEHYDRATED FOOD PRODUCTS. Fruit etc. is dehydrated in deep layers without appreciable decomposition of the fruit sugar by heating at <1 atm. (about 0.5 lb. etc.) in presence of an edible liquid medium e.g. coconut oil, petrolatum, syrup gelatin solution etc.
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THE DRYING OF COLLOIDAL FLUIDS ESPECIALLY MILK AND OTHER MATERIAL CONTAINING PROTEIN. A review of world literature and patents on methods and equipment.
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THE DEHYDRATION OF FOOD. Deals with all aspects of the dehydration of foods, and chapters on the principles and methods of drying; biological and nutritional aspects, packaging and storage.





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